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QUARTERLY

OF THE

National Fire Protection Association

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40 CENTRAL STREET, BOSTON, MASS.

National Fire Protection Association

INTERNATIONAL

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Texas State Fire Insurance Commission.
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Underwriters' Service Association.
United States Fireworks Manufacturers' Association.
Washington Surveying and Rating Bureau.
Western Actuarial Bureau (Fire).
Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinkled Risk Association.
West Virginia Fire Underwriters' Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.

Over 4,100 Associate Members

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

One of the test fires described by Mr. H. H. Hall in his article on Tank Fire Tests on page 356. Note the observation towers and layout of test apparatus. The hose streams are being directed from behind portable shields. Two of the portable foam distributors described in the article can be seen laid out at the right of the tank.

"Underwriters have no power to compel holders of insurance contracts (policies) to do thus and so—they can simply make suggestions and give advice concerning the elimination of hazards. Those who prefer to maintain fire breeding conditions and pay the piper are privileged to do so."
—W. E. Mallalieu, General Manager, National Board of Fire Underwriters, in New York *Times*.

The Quarterly

Vol. 20 April, 1927 No. 4

Thirty-first Annual Meeting. The thirty-first annual meeting to be held in Chicago May 9, 10, 11, and 12, with headquarters at the Congress Hotel, Michigan Boulevard, the first in our fourth decade, may be also the first in the epoch of our greatest accomplishment. If the project of our executives to raise enough money to put our field engineering service on its feet for a five-year period meets with success commensurate with the devoted persistence of the effort, our experiment in the field during the three years past will be expanded into a competent and fertile development.

The year marks also the affiliation of the State fire marshals with our Association and the auspicious beginning of the effort to standardize the arson laws of the country. The technical committee work to be presented at the Chicago meeting will be in normal volume. Hotel and railroad information will be given in the current *News Letters* and a copy of the official program will be mailed as usual to all members in advance of the meeting.

* * * * *

Taxes and Fire-Resistive Buildings. Should not credit on taxes be given to the owner of a fire-resistive building or of a building where there has been installed fire pumps which can be used to fight outside fires? A fire-resistive building does not contribute to the fire hazard, but acts as a fire wall. A building equipped with a fire pump is of benefit in fighting a neighboring fire.

This theory in the principles of taxation is being advanced in Chicago by Charles V. Barrett, member of the Board of Review.

"It is a logical theory," says Mr. Barrett. "The man who spends additional money to make his building safe cuts the fire hazard and the cost of government, through the fire department. He performs a public benefit. It would seem fair that he should receive some recompense in the form of a credit on his taxes.

"Were the present tax rate applied to the actual value of ground and building there would of course be no more building in Chicago. In

practice, tax officials must set a valuation which allows a fair return to the man courageous enough to build. If a man invests an extra amount in fire-proof construction and fire equipment, why should this not also be taken into consideration in fixing his taxes!"

In sending us this statement of Mr. Barrett our Chicago member, Fitzhugh Taylor, advises:

In Chicago, the Board of Review is the body to which a property owner may apply for relief if he feels that the Board of Assessors has placed too high a valuation on his property for purposes of computing taxes.

As to the last paragraph, rates of taxation in Chicago run around eight per cent to nine per cent, and it is obviously impracticable to compute and collect general taxes at these rates on the basis of actual market value of real estate. I think the assessor's valuations are therefore commonly intended to be around one-half of the market value; so that general taxes figured at the above rates amount to between four per cent and five per cent of the market value.

The Chicago *Tribune*, commenting editorially on this matter, says:

Charles V. Barrett of the Board of Review is considering a proposal to lower the taxes on fireproof buildings. At present a fireproof building, because it is more costly than one of different construction, is assessed more heavily. That is an injustice. The fireproof building, as Mr. Barrett points out, requires less protection at public expense. Besides, if fire breaks out in an adjoining building of inferior materials, the fireproof structure will serve as a means of preventing the flames from spreading. If the question were to be decided on the equities, we do not doubt that the fireproof building would be taxed at a lower rate.

This idea, expressed by Mr. Barrett, is not new in the thought of fire protection engineers, who have long believed in the justice of it. It is interesting, however, to see it expressed by a city official and approved by "the world's greatest newspaper."

* * * * *

"Fire Escapes," Old and New. Chicago is one of the few great cities in which old fashioned fire escapes are still commonly used on new buildings. These outside stairways are ugly. By the most careful study, and under the most favorable circumstances, their ugliness can be only slightly minimized. There are few instances in which they are not an eyesore. The injury they can do to otherwise good architecture is well illustrated by the new Tobey building on the Michigan Boulevard. The fire escapes have marred it even more than the unenclosed sprinkler tank which destroys the roof line and is plainly visible from the street. Before these excrescences appeared the building had no little charm.

The alternative to fire escapes is the enclosed fire stairway built inside the structure but thoroughly cut off by a curtain of masonry and fire doors from the occupied sections of the building. Such a stairway is certainly no more likely to be swept by flames than is an exterior escape. At the

same time, the exterior fire escape offers a distinct hazard, if only a mental one, to rapid descent in an emergency, and when coated with ice or swept by a high wind it is genuinely dangerous to take on the run. Even if the question of appearance were not involved, the enclosed fire stairway would be more desirable for every purpose for which it is intended.

There are none of these outside stairways to mar the new buildings of Northwestern University and the University of Chicago. There are none on the Tribune Tower. The modern buildings in New York and in practically every other city of the first rank in this country have enclosed fire stairways. Architects who continue to employ the older method without protest are chargeable with indifference to the appearance of their work. They owe it to the community to keep their clients abreast of the times, even though a slight increase in cost is involved.

* * * * *

The Quick or the Dead. With the daily massacre of pedestrians in our streets by the drivers of automobiles and the growing public revolt against such slaughter, it is natural that there should be more or less inquiry as to the wisdom of driving fire department apparatus at the high speed at which it is operated in many of our cities. One has in mind numerous occasions on which brave firemen have lost their lives by turning their trucks into the curb to avoid collisions. Certain cities have set a speed limit on fire apparatus as well as private trucks in the thought that no vehicle whatever its character or need for arriving at its destination should be allowed to attain a speed beyond reasonable control. An arbitrary speed limit for fire apparatus may not be the best method of accomplishing this, for a limit low enough to insure reasonable safety under the worst traffic conditions might unnecessarily delay the apparatus under other conditions where a higher speed might be relatively safe. In the final analysis the control is in the hands of the driver and, irrespective of laws or regulations, safety depends upon the driver, who should be in every case a competent man carefully instructed as to his responsibilities to the public.

Safety of life and property depends upon the early arrival of the fire department at the scene of a fire, but lives lost in the street and the putting of the apparatus out of commission through collision may be equally deplorable. We cannot bring ourselves to approve of the order of Safety Director Edwin D. Barry of Cleveland compelling fire apparatus to obey the regular traffic signals: an exception should be made in its case and the way should be cleared for it; but the contention that fire apparatus ought to be driven at such a rate of speed that it is always under the control of the driver, even though it may take a minute longer to reach the fire, seems reasonable. It is doubtful if the fire loss will be materially increased by a prudence aimed at saving the lives of the firemen and those

who happen to be in the streets when the alarms are being answered. A member has recently written: "I have a home, a wife and three children, but I would rather have my home burned to the ground than to have one of my loved ones killed by a fire truck on its way to save my house from destruction."

* * * * *

Science and Gasoline. The *Christian Science Monitor,* the international daily newspaper published by the Christian Science Publishing Society of Boston, printed in its issue of October 8, 1926, an item on the Woman's Page captioned, "The Busy Mother Learns to Dry Clean." This article suggested the use of gasoline in large quantities in home dry cleaning, advocating the use of the family washing machine for the purpose. The article gave no warning as to the hazards involved. To follow its advice would invite death and destruction. In accordance with usual custom in such cases the N.F.P.A. Executive Office wrote to the editor of the *Christian Science Monitor* requesting the publication of an article on the dangers of home dry cleaning which might correct some of the harm done.

About this time somewhat similar articles appeared in the New York *Sun* and in several other newspapers, presumably either inspired by the *Christian Science Monitor* or taken from the same source of information. The New York *Sun* and the other publications in every case responded promptly to letters written by the Executive Office or by local members, publishing appropriate articles on the hazards of the home use of gasoline which did much to correct the harm done by original articles and inform the public as to the dangers involved.

After a considerable delay, a reply was received from the editor of the Women's Departments of the *Christian Science Monitor* admitting the error and agreeing to publish an appropriate correction of the article. The N.F.P.A. Executive Office accordingly prepared an article based upon the circular on home dry cleaning which had been distributed to members with the *News Letter* a few months previously. This was not printed by the *Monitor* and after a further delay there came a letter signed by Mrs. Helen Johnson Keyes, Editor of the Women's Departments of the *Monitor,* reading as follows:

> I regret exceedingly that after a long delay the editors of the *Christian Science Monitor* in Boston have decided that they do not wish to reopen the question of home use of gasoline. We shall avoid all reference to the use of explosive cleaning fluids in future articles, but it is considered wiser not to discuss the dangers connected with them.

The editorial policy of the *Monitor* minimizes reference to the ills and unpleasantnesses of life, and seems to place gasoline explosions and bodily ailments in the same category!

Pigs and Sprinklers. Near a city recently visited by one of our field engineers there is a city poor farm, whose inmates are housed in a large building, where those recipients of the city's benevolence, not too enfeebled for physical labor, contribute to their support by working on the farm which yields a good annual revenue from the fattening of hogs for market. For some time the city fathers have realized the fire hazards of this almshouse which is so far out in the country that the protection of the municipal fire department is not immediately available. Recognizing the responsibility for the safety of these unfortunates, the municipal government appropriated some thousands of dollars for the installation of an automatic sprinkler system for this building, an eminently wise and proper measure.

The proposed protection is indeed necessary, as the building is an old four story structure, of ordinary wooden interior construction, open stairways throughout, inadequate exits, and bars on the windows of the lower floors. For fire protection the farm boasts a gasoline pumper, discarded by the city fire department, but supposedly in good condition. One man employed at the farm is familiar with the operation of this engine. Enquiry disclosed that no one else on the premises knew anything about it, and on the day of our field engineer's visit this man was reported off duty on account of illness.

When the superintendent of this institution learned that an appropriation had been made for the poor farm, he had other ideas as to how the money should be spent. His report to the city council expressed the opinion that automatic sprinklers were quite unnecessary, but that other improvements were urgent. He had in mind an elevator for the inmates and, according to the statements of the local newspapers, some new and improved quarters for the pigs!

Our field engineer conferred with the mayor; the mayor conferred with the superintendent; the superintendent, then understanding the hazards of the building and the efficacy of automatic sprinklers, withdrew his report; and the sprinklers are to be installed.

* * * * *

An Impending Conflagration. The Board of Aldermen of New York City passed, on January 11, 1927, the ordinance prohibiting wooden shingle roofs throughout the limits of Greater New York. (See *News Letter,* February, 1927.) This is a great single advance toward eliminating fire-breeding roofs in this country. The ordinance prohibits the further use of wooden shingles and provides for the total abatement of this particular conflagration hazard in New York City *fifteen years hence* when all roofs shall be fire-retarding. In the meantime there will be more than ordinary likelihood of a conflagration through the agency of wooden shingle roofs in the closely built suburban

sections of the city. Until these combustible roofs are largely replaced every fire is a potential conflagration. As evidence of the hazard of existing shingle roofs Fire Commissioner John J. Dorman describes three multiple-alarm shingle roof fires that occurred during 1926 as follows:

"On April 20, 1926, a fire originated in the 3½ story frame rooming house situated at 216 Beach 71st Street, Arverne. This fire not only originated in the roof shingles but extended to the roof shingles of six other buildings, some of which were considerably damaged. A contributing cause to the extension of this fire was the high wind which was blowing at the time of its discovery. This fire caused a total damage of about $8,000.

"On June 10, 1926, a fire originated in the 2½ story frame building in course of construction at 170 118th Avenue, St. Albans. This fire extended from the building in which it originated to nine other buildings by means of sparks igniting wooden shingles. While the building in which the fire originated was only damaged to the extent of $3,500, the extended loss caused by this fire amounted to over $14,000.

"On July 23, 1926, a fire originated in the two-story frame rooming house at 254 Beach 81st Street, Hammel, and extended to the wooden shingles on adjoining building. The damage caused by this fire was in excess of $2,500.

"In addition to the fires mentioned, which were of recent date and did considerable amage, there have been very many small fires that were confined to the shingled roofs in which they started, and in many cases these latter fires were caused by sparks from chimney."

The above fires are typical of those likely to occur during the spring and summer this year and in succeeding years and a conflagration as a result of any one of them should surprise no one.

Courtesy New York *World*.

"That's the second time that the old dame called us out on account of her kitchen being full of burnt bacon smoke!"

John Cassel
in the New York
Evening World.

Gar in the
Philadelphia
Public Ledger.

Meeting of Executive Committee.

January 15, 1927.

The midwinter meeting of the executives was held at Atlantic City on January 15, 1927. The following members were present:

A. T. Bell, Atlantic City, Chairman
Dana Pierce, Chicago, President
Frank C. Jordan, Indianapolis, Vice President
Rudolph P. Miller, New York, Past President

Eugene Arms, Chicago	F. T. Moses, Providence
W. H. Blood, Jr., Boston	W. W. Orr, New York
Geo. W. Booth, New York	Hickman Price, New York
Geo. W. Elliott, Philadelphia	Sumner Rhoades, New York
Geo. H. Greenfield, Montreal	Paul W. Terry, St. Louis
S. D. McComb, New York	Louis Wiederhold, Jr., Philadelphia
H. L. Miner, Wilmington, Del.	Franklin H. Wentworth, Boston, Secretary

Mr. A. R. Small, Chairman of the Electrical Committee, was present by invitation.

Business Transacted.

The change in the place of the annual meeting from Memphis to Chicago was confirmed.

The plans for a finance campaign submitted by the special finance committee, S. D. McComb, Chairman, were approved and it was voted to employ the firm of Tamblyn and Brown, as special campaign advisers as recommended by the committee.

The contract submitted by Tamblyn and Brown was discussed and approved, and the President and Secretary authorized to sign the same for the Association.

A general campaign committee was appointed as follows:

S. D. McComb, New York, Chairman
Eugene Arms, Chicago
A. T. Bell, Atlantic City (ex officio)
W. H. Blood, Jr., Boston
Geo. W. Elliott, Philadelphia
H. L. Miner, Wilmington
W. W. Orr, New York
Dana Pierce, Chicago (ex officio)
Hickman Price, New York
Franklin H. Wentworth (ex officio)

Vice President Frank C. Jordan and Secretary Wentworth were appointed a committee to report to the June meeting of the Executive Committee on the advisability of accepting advertising for Association publications.

It was voted to authorize the Electrical Committee to set up a body within itself to serve as an interpreter where desired of the provisions of the National Electrical Code.

The recommendation of the Electrical Field Service Committee that its work be continued along the lines of its present effort was unanimously approved.

The Secretary was requested to appoint a committee of five to report to the Executives a plan for the guidance of technical committees in eliminating from or segregation of construction specifications for devices and materials appearing in the Association's standards. The Secretary appointed the following committee: Dana Pierce, Chairman; H. O. Lacount, Geo. W. Booth, H. L. Miner, Sumner Rhoades.

The report of the Committee on Dust Explosion Hazards proposing the adoption of revisions in the Regulations on Pulverized Fuel Equipments was discussed and the committee instructed to present the revisions to the next annual meeting for adoption, forwarding the revisions to the Executive Office for immediate printing in advance report form if desired.

The Building Exits Code, revised by the Committee on Safety to Life, as authorized by the 1926 annual meeting, was adopted and the Executive Office authorized to transmit the code to the American Engineering Standards Committee for approval as a tentative American Standard.

The Committee on Automatic Sprinklers was instructed to refer their recommendations on local sprinkler alarms of the electric type to the Committee on Signaling Systems. The Committee on Signaling Systems was instructed to give consideration to these recommendations of the Committee on Automatic Sprinklers for incorporation in the Regulations on Signaling Systems, reporting thereon at the next annual meeting of the Association if possible.

On recommendation of the Committee on Protection of Openings in Walls and Partitions a revision in phraseology of a part of the 1926 report of this committee (Proceedings 1926, page 234) was approved.

PART III. VERTICAL DOORS.

27 (c) (Page 43). Revise to read as follows:

(c) **Pulleys and Counterweights:** Doors of more than 4 feet in vertical dimension and doors at openings through which persons will pass, shall be provided with two counterweights and a counterbalance. (See Fig. 24 for arrangement.) Doors less than 4 feet in vertical dimension and doors at openings through which there can be no passage of persons—such as ducts, conveyors, etc.—may be provided with a single counterweight and a counterbalance instead of double counterweights and a counterbalance.

The total weight of the counterweights should be sufficient to prevent the door from dropping suddenly, but not sufficient to prevent it from closing in a positive manner when the auxiliary counterbalance used in connection with the

automatic device is released. The two permanent counterweights shall be of equal weight so that there will be no tendency of the door to cock or bind in the guides.

On recommendation of the Committee on Tanks the following amendments to the Regulations governing Tanks, were approved:

Article 3401—Add sentence at end: "Combustible frost-proof casings subjected to serious fire exposure shall be protected by at least 1 inch of cement plaster on metal lath."

Article 3604—Add the following as a third paragraph of the fine print note: "Air-lock may be conveniently prevented in new equipments by connecting the gravity tank and pressure tank discharge pipes together 40 feet or more below the bottom of the pressure tank."

Article 3705—Change text to read: "The water-filling pipe and air-supply pipe shall be connected to the tank above the water-level in an approved manner, generally by means of a single 2 inch x ¾ inch x 2 inch tee-fitting connected to the tank by means of a 2 inch nipple. The tee-fitting shall be as indicated in Figure 11 with the 2 inch end-outlet screwed onto the 2 inch tank nipple and the single water-filling and air-supply nipple connected into the 2 inch side-outlet."

Article 3706—Change last three sentences as follows: "The water-level gauge shall be connected to the top of the filling tee and extended 6 inches into the tank as shown in Figure 11. A pet cock shall be provided for draining the glass. All fittings and nipples shall be of brass not less than ¾ inches in size, except that the nipple extending into the tank may be ½ inch."

Minor changes have been made in Figures 1, 2, 3, 4, 5, 7, and 11 to conform with the changes made in the report at Atlantic City and with the above alterations in the text.

The following revisions of and additions to technical committee rosters were confirmed:

1. **Blower Systems:**
   J. L. King appointed Secretary
2. **Building Construction:**
   Franklin R. McMillan representing Portland Cement Association, vice W. E. Hart
3. **Dust Explosion Hazards:**
   R. W. E. Moore representing National Electrical Manufacturers Association
   George S. Rice representing U. S. Bureau of Mines
4. **Electrical:**
   John S. Caldwell representing New England Insurance Exchange, vice Ralph Sweetland
   John Price Jackson representing American Institute of Electrical Engineers, vice Paul Spencer
5. **Electric Power Houses:**
   A. H. Moore representing Electric Power Club
6. **Field Practice:**
   C. B. Langdon, Chairman, vice H. P. Smith resigned

7. **Garages:**

F. H. Alcott representing Committee on Building Construction
G. C. Hecker representing American Electric Railway Association
A. D. Knox (Connecticut Co.)
R. E. Plimpton (Editor, Bus Transportation)
John Stilwell representing Society of Automotive Engineers
O. M. Walther representing American Society of Heating and Ventilating Engineers
R. P. Whitmer representing National Warm Air Heating and Ventilating Association

8. **Gases:**

I. Osgood representing Boston Board of Fire Underwriters

9. **Manufacturing Risks and Special Hazards:**

F. D. Ross representing Factory Insurance Association, vice H. P. Smith

10. **Private Fire Supplies from Public Mains:**

F. D. Ross representing Factory Insurance Association, vice H. P. Smith

11. **Safety to Life:**

R. G. Kimball representing National Lumber Manufacturers Association

12. **Signaling Systems:**

Jacob Grimm representing International Association of Municipal Electricians, vice Louis Gascoigne

The following appointments of N.F.P.A. members for service on committees of other organizations were confirmed:

A. E. S. C. Committee on Method of Test for Flash Point of Volatile Flammable Liquids:

George W. Angell
A. H. Nuckolls

A. E. S. C. Committee on Symbols for Electrical Equipment of Buildings: Dana Pierce (old appointment continued)

A. E. S. C. Committee on Specifications for Rubber Lined Fire Hose: Ross Davis

National Safety Council Committee on Spray Painting: H. L. Miner, N.F.P.A. representative

A communication regarding the hazards of the chemical treatment of cigarette wrappers to improve their burning qualities was discussed and referred to the Secretary.

Photograph Courtesy Flintkote Co.

Replacing Burned Poles and Wiring at Woburn, Mass.

The left of this picture shows a portion of the ruins of a group of frame tannery buildings destroyed by fire in Woburn, Mass., on February 2, 1927. The buildings were of inferior construction, and to the casual observer the loss may not have seemed serious. Every fire, however, is apt to involve indirect losses which are not considered by the casual observer. The losses due to ignition of the buildings on the right of the street and the destruction of another building nearly half a mile away by flying brands alighting on a wooden shingle roof were obvious consequences of the fire. In front of the buildings burned there were poles carrying the wires supplying electric current for a considerable section of the city beyond. These poles had to be replaced and new wires strung. On the poles may be seen a few of the men comprising the large emergency crew sent to the scene of the fire by the electric light company. The territory served by this line was without electric light and power service for some time and the public utility company was put to considerable expense and inconvenience in replacing the destroyed electric wiring and poles. This illustrates one of the many kinds of indirect fire damage which are overlooked by the thoughtless individual who misguidedly thinks that the best way to get rid of a fire trap is to burn it up and collect the insurance.

Big Fires.

An Editorial in the Des Moines Register.

The very beginning of wisdom for the new year is to think our way through in the matter of big fires.

"What the city needs is a big fire," is one of our common remarks. The observation is emphasized by pointing to San Francisco, to Spokane, and to Chicago.

And yet New York City is rebuilding faster than any city in the world without having a big fire, and the one thing all enterprising cities are guarding against is the threat of big fires.

It is true that a number of cities have survived big fires and have rebuilt on larger scale. But who is at any pains to make note of the cities that are ruined by big fires, that never rebuild? If we look to the ancient world, substantially every great city went down in conflagration or earthquake and never rebuilt.

One of the most misleading forms of reasoning is "after the event because of the event," Chicago became bigger than ever, therefore fire benefited Chicago. But in matters of our own personal experience we do not reason that way. We may survive a great setback in health or in business, but we never credit our later achievements to the setback. We figure that without it we should have been that much further ahead.

Why if New York is rebuilding at the most astonishing rate known to the cities of the world does it take a big fire to give the energies of the new generation scope? Is it not possible that in orderly ways cities can be kept up to date? Is it not possible that New York is using the labor of the people to take down and rebuild and thereby keeping all the various avenues of activity open, where a big fire would disjoint industry, throw people out of employment, and generally disorganize industry?

Why is it the particular aim of every city to avoid fires? Why do all the city organizations point out the needless loss of fires? Why is it figured what the farms of America lose annually by fires? Why is it necessary to have insurance against fires to enable the community as a whole to share a loss that would wreck individuals? Why in general is the industrial and social progress of the world figured in terms of protection and insurance against fires?

How can anybody answer these questions and then continue to say in that heedless and thoughtless way that what cities need most is big fires?

Chicago did rebuild, and San Francisco is handsomer than ever, but why point to a few cities that have survived and gone ahead, when the rule

is so universal and the experience of the race in all history so uniform, that nobody can possibly be deceived?

Admit that there must be replacement, admit that old buildings must be removed, admit that new times demand new architecture, why should anybody jump to the conclusion that a big fire is the way, when fires take the good with the bad, frequently take only the good, and bring on an indiscriminate destruction of both life and property that discourages the rebuilders, buries their resources and takes away their credit?

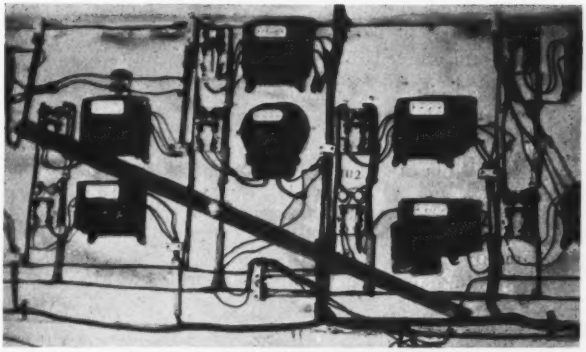
But big fires bring out certain heroic traits of character. Those who were at the world's fair in Chicago will remember the firemen caught in the tower who slid down the rope into a cloud of flame and smoke they could not see through and dropped off one by one into the inferno beneath them.

Everybody wishes to honor the heroism of the firemen, but why in doing that glorify the fire? Why in building a monument to the heroism of fire fighters, build a monument to fires at the same time? Every big fire brings out real heroes. They save women and children from impossible places, they take enormous chances, their bravery becomes a watchword for the schools. But must we encourage big fires in order to have heroes? If a member of our own family lost his life in a heroic rescue must we forever glorify the fire that called him out?

The time has come to think our way through in this matter of big fires and to understand that the only city progress the world has made is protection of life and property against them. To the extent that they still threaten they are a calamity, and no possible deeds of heroism on the part of the fire fighters ought to blind our eyes to the extent of the calamity. No city ever benefited by a fire. If a few cities have rebuilt the waste places, that merely hints what they might have done better if it had not been for the waste. The handsome cities of the world are the only ones that have come up in steady development by orderly process of growth and replacement. The devastated cities are uniformly the cities of big fires.

To the extent that we have honored the fire fighter by building monuments to fire we have to that extent misplaced the emphasis. Every monument to fire, under the guise of honoring the heroism of firemen, is a monument to misunderstanding. All we prove by such monuments is that we do not know the forces that make for the building of great cities.

All Set for a Fire.



Above, on the wall, a defective installation of meters, fuses and wiring, with a wooden yardstick wedged between the wires. Sparks or hot metal from this would fall into—

—the pile of rubbish on the floor directly below!

Photographs of conditions discovered in the basement of an office building. —*Hartford Agent.*

The Atlantic City Speedway.

The grandstand erected to hold spectators at the Atlantic City speedway at Amatol, N. J., about 25 miles west of Atlantic City, is a huge frame firetrap. N.F.P.A. members en route to the last annual meeting noticed the stand and many expressed amazement that such a structure should ever have been built. While in Atlantic City on that occasion the N.F.P.A. field engineers went out to the speedway to observe it more closely and took some of the pictures here reproduced.

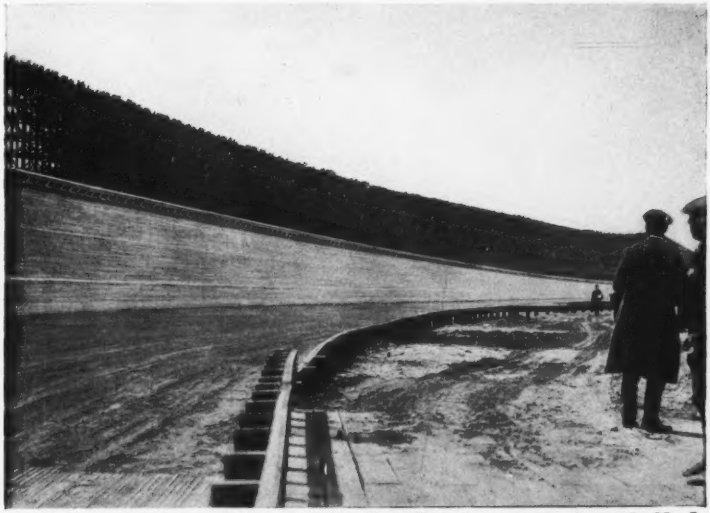
As a result of the subsequent work of the Field Service Department the State of New Jersey has passed a bill authorizing the State Department of Labor to promulgate a suitable building code and to supervise the construction of places of assembly in communities where there are no local building regulations.

From these illustrations some idea of the construction of the speedway grandstand can be obtained. It is built of the flimsiest kind of wooden construction about a quarter of a mile long and of a height approaching 100 feet—a veritable forest of wooden posts and joists, a volume of some 6,000,000 cubic feet and roughly equivalent to a frame building four stories high and 130,000 square feet in area.

For exits there are provided seven steep ramps, 15 feet wide, leading down through the middle of the structure at various points, the five center ones dividing into two ramps 8 feet wide. These exits are totally inadequate for the seating capacity of 26,000 people. At a race on May 1, 1926, the stand, which was not filled, required nearly 40 minutes to empty. The construction is such that in a very few minutes, a fire could involve a large section of the structure and the possibilities of loss of life by fire or panic are appalling.

That the persons responsible for the design and construction of this firetrap are not entirely insensible to the fire hazard is shown by the following fire protection measures taken.

For water supply there is a 5,000 gallon storage tank at a 50 foot elevation (the stand is nearly 100 feet high), and a 138 foot artesian well. This water is distributed through a 4-inch main running along the back of the stand, on which are connected three hydrants. A supply of hose on a small motorized hose wagon is provided. Twenty-five 2½ gallon fire extinguishers are distributed through the grandstand. There is a caretaker on the premises, which are enclosed with a high wire fence. It is stated that there is a patrol on duty 24 hours a day and that during races, 28 special watchmen are employed: fourteen of these are on duty in the



The grandstand of the Atlantic City Speedway near Amatol, N. J., nearly filled on the occasion of a race shortly after its completion early in 1926. The stand, which will hold some 26,000 persons, is a huge combustible structure, inadequately provided with exits and constructed with singular disregard for life safety.

grandstand, cautioning spectators against smoking and an equal number are underneath the grandstand looking out for lighted cigarettes and taking necessary measures to stamp out fires. By arrangement, the fire departments of Hammonton and Egg Harbor each furnish one company during the time the races are in progress.

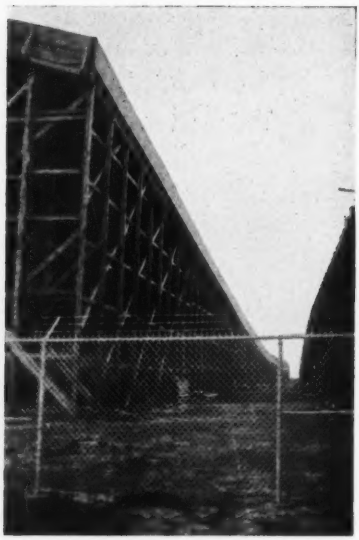
The speedway is located in a sparsely settled part of the state at a point not in or near any city or town where there was any local inspection authority or ordinance to safeguard it, and the state laws at the time contemplated no supervision for structures of this sort.

Following the annual meeting Field Engineer Bugbee brought this matter to the attention of the state authorities, conferring with Governor O. Harry Moore, Comptroller N. A. K. Bugbee, Deputy Commissioner of Labor Charles H. Weeks and others. Governor Moore asked for definite suggestions and the following recommendations were made by Mr. Bugbee.

1. That the speedway grandstand be closed by the state through its police power until proper measures had been taken to insure a reasonable degree of safety from possible fire and panic.

2. That the state employ a competent engineer to investigate (a) the structural safety, (b) the exit facilities, and (c) the fire protection of the grandstand.

3. That the state should enact a building code to cover all places of assembly not covered by local building codes.



A closeup of the front of the grandstand, its lowest part. This shows the minimum height (approximately that of a three-story building) from which spectators would have to drop should fire make the other exits inaccessible.

Acting on Mr. Bugbee's suggestion that an engineering survey be made, Governor Moore asked the National Board of Fire Underwriters to render a report on the structure. Accordingly the speedway was visited and a report made by Messrs. J. H. Howland and Frank H. Alcott (Member N.F. P.A. Committee on Safety to Life). Briefly their recommendations were the following:

1. A check-up on the structural safety of the grandstand by a competent engineer.

2. Provision for six emergency exit ramps, 10 feet wide running down to the twenty foot space in front of the grandstand.

3. Provision of vertical fire stops of wire lath and plaster for three of the six existing ramps.

4. A state building code to take care of such structures in the future and to be enforced by the State Labor Department.

5. A new water supply to deliver 500 gallons per minute at 100 pounds pressure.

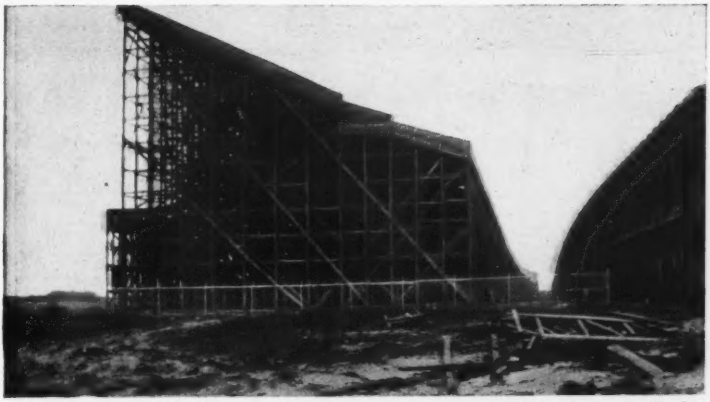
6. Provision to thoroughly wet the stand and ground underneath the stand before each race.

7. Provision of an adequate number of men to man the fire equipment on the day of each race.

Just about this time the Newark Velodrome, a cycle track and grandstand of practically the same type of construction as the speedway, burned to the ground, providing a striking example of the hazard of this type of structure.

Governor Moore brought the engineers' recommendations to the attention of the speedway owners and to the local authorities, explaining that the state had no power in the matter. He said, however, that if the owners, after being given a reasonable opportunity to comply with the recommendations, failed to do so, he could turn the reports over to the Grand Jury who could indict the owners for maintaining a structure that is a hazard to the public.

Since that time no attempt has been made to use the structure, and it is understood that the enterprise has not been a financial success and that there is little likelihood of its being again used. While the State Depart-



A side view of the grandstand and race track which shows well the flimsy construction and the great height. It will be noted that there are no exits at the ends or front of the stand.

ment of Labor, under the provisions of the bill recently passed, has supervision only of structures of this type erected hereafter, if any attempt is made to use the structure in the future, it will be in a position to insist that the above safety measure be carried out or it can do what Governor Moore says is possible: place the evidence that the owners are maintaining a hazard to the public in the hands of the Grand Jury.

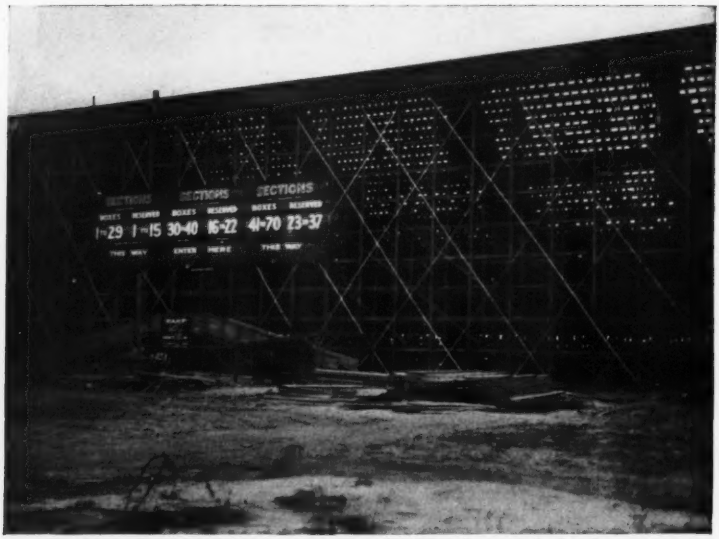
With further reference to the state building code recommended for places of assembly, Governor Moore in his annual message asked the Legislature to pass such a law. In the meantime the Department of Labor, at Field Engineer Bugbee's suggestion, prepared the following bill, which was satisfactory to the Attorney General and the Governor, and this was accordingly introduced into the Legislature:

STATE OF NEW JERSEY.

AN ACT relating to the construction of theatres, opera houses, grandstands and buildings used for motion picture purposes, and other public entertainment, in the municipalities of this State, which have no local building supervision.

BE IT ENACTED by the Senate and General Assembly of the State of New Jersey:

1. In all municipalities of this State, which have no local building supervision, no theatre, opera house, grandstand, or building used for motion picture purposes, or public entertainment of any kind, shall hereafter be erected or used in whole or in part for such purpose unless the plans and specifications therefor shall first have been approved by the Commissioner of Labor, and all such theatres, opera houses, grandstands and buildings used for motion picture purposes, or public entertainment, shall in all respects conform with the standard of requirements maintained by the Department of Labor for such construction.



The grandstand from the rear showing the forest of slender supports. The one ramp at the left is the only exit for approximately the entire seating area in the part of the stand shown in this picture.

2. The Commissioner of Labor, in accordance with the provisions of this act, shall prepare and promulgate a building code, due attention being paid to fire prevention and protection features, proper egresses, aisle spaces, doors, door openings, stairways, partitions, fire escapes, fireproofing, fire apparatus and all equipment used.

3. Before any such construction as aforesaid, shall be undertaken, the plans and specifications therefor, in duplicate, shall be submitted to the Commissioner of Labor, and if found to be in accordance with the provisions of this act, and the code authorized to be adopted hereunder, the Commissioner of Labor shall approve the same, retaining a duplicate copy of the plan in his department.

4. All plans and specifications must be accompanied by an application form, furnished by the Department of Labor, together with an examining fee of three dollars for buildings or constructions not exceeding three stories in height, and a fee of five dollars for any building or structure exceeding three stories; PROVIDED, HOWEVER, that a structure more than forty-five feet in height shall be deemed to be a building of more than three stories.

5. Any person, firm or corporation violating the provisions of this act shall be liable to a penalty of two hundred dollars for each offense, and each day that such violation continues shall be deemed a separate offense.

6. The supervision of theatres, opera houses, grandstands and buildings used for motion picture purposes, and for public entertainment of any kind, in municipalities having no local building supervision, shall in all respects conform to the code prescribed by the Commissioner of Labor, and no alteration shall be made in any such building, after a certificate has once been issued, unless application for such alteration is made to the Commissioner of Labor.

7. The Commissioner of Labor is authorized to bring an action for the recovery of any such penalty in the nature of an action in debt in the small cause court of any county, the district court of any city, or judicial district, or the County Common Pleas Court of any county. The practice and procedure in all such actions shall conform to the practice and procedure prevailing in the court in which action is instituted. All penalties recovered by virtue of this act shall be paid to the Commissioner of Labor for the use of the Department of Labor.

8. This act shall take effect immediately.

This bill passed the General Assembly and Senate and was signed by the Governor. The state officials were anxious to cooperate and expedited the passage of the act which will provide for the future safety of places of assembly in New Jersey.

Mr. Charles H. Weeks, Deputy Commissioner of Labor, who is charged with the enforcement of the new law, has now asked the Field Service to suggest a suitable building code, and the Field Service is cooperating with him in the preparation of a suitable set of requirements to carry out the purposes of the above law.

Award for Injuries at Fire.

By settling out of court, a case of far-reaching importance to the fire service was brought to a close recently. Former Battalion Chief Thomas Murtagh sued Miss Alice De Lamar, a New York society woman, for $150,000, claiming damages to that amount arising from an explosion of gasoline vapor during a fire in Miss De Lamar's garage.

Chief Murtagh was badly burned in this explosion. He was found to be incapacitated for service and was retired on full pay.

By the taking of this case out of the courts, and reaching a compromise, Former Chief Murtagh has saved himself a long drawn out legal battle and attained the same end, as the very fact that a compromise was effected shows that the case of the chief was regarded by the defendant's attorneys as strongly in his favor.

When, as in the present case, the violation of fire protection laws has been called to the attention of the offending party, and nothing has been done to correct the condition, the violator is liable for any injury that a member of a fire department may suffer by this neglect. Even if the condition existing has not specifically been called to the attention of the violator, he or she is still liable for any resulting injuries, as a knowledge of the law on the statute books is presupposed and ignorance of it is no excuse.

Thus, the case of Chief Murtagh can be regarded as a very important precedent for the laws protecting the members of fire departments injured through the neglect of citizens to obey these statutes.

—*Fire Engineering.*

A Table of Fire Department Salaries in U. S. and Canada.

City	Population.	No. Men.	Chief.	Deputy or Asst. Chief.	District or Battalion Chief.	Captains.	Lieuts.	Maximum Pay.	3d year.	2d year.	1st year.	Master Mechanic.	Engineers.	Chauffeurs	Electrician.	Fire Alarm Operator.	Secretary to Chief.
New York, N. Y.	6,000,000	6,052	$10,000	$7,500	$4,490	$3,700	$3,200	$2,500	$1,980	$1,779	$1,779	.....	$4,920	.....	.....	$2,976	.....
Chicago, Ill.	3,000,000	2,303	8,000	6,800	4,000	3,200	2,900	2,500	2,440	2,320	2,140	$4,500	2,580	.....	.....	3,720	$4,350
Philadelphia, Pa.	2,000,000	1,900	5,500	3,500	2,650	2,250	2,150	2,007	2,007	1,642	1,642	.....	2,050	.....	.....	2,200	1,750
Detroit, Mich.	1,436,000	1,466	6,000	4,500	3,750	2,940	2,640	2,400	2,400	2,200	2,100	.....	2,560	.....	.....	2,560	1,860
Los Angeles, Calif.	1,200,000	1,530	6,000	5,400	3,600	3,000	.....	2,400	2,280	2,160	2,040	.....	2,700	$2,580	$45.00 week.	.....	3,600
Cleveland, Ohio	936,485	1,069	5,600	3,840	3,081	2,388	2,272	2,104	2,104	2,104	1,800	3,462	2,370	.....	2,272	2,272	3,081
St. Louis, Mo.	900,000	975	5,000	3,600	3,000	2,520	2,280	2,160	2,160	2,160	1,680	3,300	2,280	2,160	.....	.....	3,000
Baltimore, Md.	810,000	1,425	5,000	3,800	2,900	2,000	1,875	1,700	1,700	1,600	1,500	2,900	1,950	.....	2,000	2,300	3,200
Montreal, Que.	800,000	930	5,000	3,600	2,800	2,160	1,980	1,700	1,600	2,200	1,300	2,160	1,800	.....	.....	1,550	18,00
Boston, Mass.	780,000	1,470	5,500	4,000	3,500	2,500	2,300	2,000	1,800	1,700	1,600	.....	2,100	.....	.....	2,000	1,700
Pittsburgh, Pa.	700,000	906	5,000	3,500	3,000	2,460	2,250	2,040	2,040	1,920	1,800	3,500	.....	2,124	.....	2,310	2,340
Buffalo, N. Y.	590,000	946	5,800	3,786	3,072	2,850	2,550	2,350	2,350	2,350	1,950	3,072	2,370	.....	.....	2,370	2,730
Toronto, Ont.	590,000	650	6,000	3,896	2,827	2,052	1,972	1,812	1,692	1,572	1,452	2,252	.....	.....	.....	1,812	2,827
San Francisco, Calif.	590,000	1,100	7,200	4,800	4,200	2,820	2,670	2,400	2,400	2,280	2,160	.....	2,640	2,520	.....	.....	.....
Milwaukee, Wis.	569,000	723	6,000	3,600	3,120	2,420	2,280	2,040	2,040	1,980	1,920	3,120	2,280	.....	.....	2,040	2,940
Washington, D. C.	486,936	863	5,200	3,500	3,250	2,500	2,350	2,100	2,100	1,900	1,800	2,730	.....	.....	1,800	1,740	3,300
Newark, N. J.	475,000	850	6,000	5,000	4,000	3,200	3,000	2,500	2,400	2,300	2,100	4,500	2,500	2,500	Union scale.	2,500	3,900
Minneapolis, Minn.	475,000	530	5,000	3,600	2,880	2,280	2,220	2,040	2,040	1,920	1,800	3,120	2,160	2,100	.....	2,220	3,120
Kansas City, Mo.	455,973	493	4,700	3,600	2,610	1,895	1,752	1,620	1,620	1,620	1,560	2,400	.....	1,680	1,895	1,895	.....
New Orleans, La.	420,000	676	5,000	3,375	2,625	1,800	1,740	1,500	1,500	1,500	1,500	2,625	1,725	1,575	.....	.....	.....
Cincinnati, Ohio.	412,000	615	6,000	4,000	3,500	2,150	2,050	1,800	1,800	1,700	1,600	3,500	2,000	1,850	2,180	2,230	2,200
Seattle, Wash.	411,000	652	6,000	3,420	3,000	2,640	2,400	2,160	2,100	2,040	1,940	3,000	.....	.....	2,400	2,400	2,640
St. Paul, Minn.	350,000	457	4,000	3,624	2,677	2,083	.....	1,838	1,797	1,658	1,598	3,255	1,960	.....	.....	.....	2,040
Indianapolis, Ind.	350,000	647	4,000	3,182	2,582	2,382	2,182	1,916	1,916	1,916	1,916	2,582	1,982	1,982	1,982	1,916	2,382
Portland, Oreg.	350,000	490	4,800	3,744	3,000	2,640	2,496	2,232	2,160	2,070	1,950	3,000	2,400	.....	2,400	2,520	2,700
Atlanta, Ga.	326,847	324	5,000	3,066	.....	2,372	2,352	2,080	2,000	1,890	1,700	2,640	2,126	.....	2,126	2,126	3,066
Jersey City, N. J.	325,000	580	6,500	5,000	4,000	3,000	.....	2,500	2,100	2,100	2,100	4,000	.....	2,500	.....	2,500	3,500
Rochester, N. Y.	325,000	498	4,700	3,500	2,700	2,300	2,200	2,000	2,000	2,000	1,700	2,600	2,100	2,000	2,000	2,000	2,600
Columbus, Ohio.	325,000	353	3,720	2,880	2,340	2,220	2,040	1,920	1,860	1,800	1,680	2,550	.....	.....	1,980	1,980	2,580
Toledo, Ohio.	303,000	436	4,200	3,690	3,150	2,730	2,610	2,400	2,400	2,160	1,980	2,640	2,560	2,400	.....	2,730	3,090
Oakland, Calif.	300,000	393	5,400	4,200	3,600	2,820	2,670	2,400	2,400	2,280	2,160	3,900	2,640	2,520	.....	2,580	.....
Denver, Colo.	300,000	367	4,200	3,000	2,700	2,160	2,040	1,920	1,860	1,800	1,740	2,580	2,040	.....	1,920	1,920	.....
San Antonio, Tex.	275,000	257	3,000	2,100	1,590	1,560	1,440	1,320	1,320	1,320	1,320	2,100	1,380	1,380	2,100	1,500	1,800
Ave., 10 Cities,	200,000–250,000	308	4,265	3,023	2,555	2,154	2,088	1,803	1,779	1,738	1,611	2,524	2,058	1,720	2,115	1,905	2,175
" 8 "	150,000–200,000	259	4,247	3,108	2,718	2,245	2,087	1,881	1,829	1,741	1,642	2,609	2,049	.....	2,351	1,927	2,312
" 19 "	125,000–150,000	162	3,822	2,896	2,660	2,243	2,126	1,942	1,889	1,828	1,668	2,498	2,078	2,009	1,984	1,877	2,261
" 25 "	100,000–125,000	162	3,479	2,644	2,369	2,138	2,040	1,850	1,824	1,728	1,576	2,285	1,855	1,818	1,900	1,801	1,879
" 23 "	75,000–100,000	99	3,413	2,559	2,541	2,146	2,072	1,878	1,868	1,817	1,707	2,286	2,058	1,940	2,212	1,970	2,043
" 62 "	50,000– 75,000	78	3,081	2,393	2,291	1,987	1,937	1,775	1,751	1,693	1,564	2,180	1,737	1,680	2,024	1,698	1,799
" 97 "	25,000– 50,000	42	2,633	2,117	1,559	1,889	1,780	1,715	1,693	1,640	1,559	2,023	1,789	1,717	1,875	1,647	1,811
" 107 "	10,000– 25,000	18	2,068	1,755	.....	1,706	1,649	1,541	1,548	1,518	1,456	1,766	1,611	1,582	1,717	1,368	2,070

Fire Department Salaries, U. S. and Canada.

By George J. Richardson, Secretary,
International Association of Fire Fighters (Member N.F.P.A.)

The table of fire department salaries in the United States and Canada on the opposite page has been compiled by the Executive Office of the International Association of Fire Fighters from the results of questionnaires sent to all cities in the United States and Canada of 10,000 population and over. The original data in the form shown in the table is available for all cities in the country, but in order to conserve space and because the average figures of the smaller cities may be of more value than the individual records for each, average figures only are given for the cities of less than 250,000. These figures have been compiled during the first two months of this year and give the latest available data. In some cases recently increased salary scales in individual cities have been included in the tabulation, although these in one or two cases do not go into effect until July 1927.

The number of men in any given fire department in proportion to the population of the city will depend so much upon local conditions that it is difficult to make any valid generalizations. The table shows that the number of men in the fire department per 10,000 population of the city varies in most cases between 10 and 15, with a few cities above and below. New York City with a population estimated at 6,000,000 has some 6,000 men in the department, the ratio being approximately 10 men per 10,000 population. Chicago, with 2,303 men for an estimated population of 3,000,000, falls somewhat below the general average in fire department personnel, the figure in this case being 8 per 10,000 population. Philadelphia, Detroit, Cleveland, St. Louis, and Montreal have a fire department personnel not far from the average of 10 men per 10,000 population. Los Angeles, with 1,530 men and 1,200,000 population, has approximately 13 men per 10,000. Baltimore, with 1,425 men and 810,000 population, shows more than 17 men per 10,000. Boston, with 1,470 men and 780,000 population, has 19 men per 10,000. These differences obviously do not so much represent variations in the effectiveness of the fire department as they do differing conditions. The Boston Fire Department, for example, has to protect the high valued district for the Boston metropolitan area which has a total population of two or three times that indicated in the census count of Boston proper. The method of fire department organization and the question as to whether or not fire prevention and salvage forces are included in the fire department personnel or separately organized also has a

bearing on this point. In the smaller cities the inclusion of volunteer fire departments affects somewhat the general averages.

The table of salaries is for the most part self-explanatory, the salaries of the higher officers varying in accordance with the size of the city and with other local conditions. The blanks in the table indicate that the cities in question have no special ratings in the classifications indicated. The average figures of the salaries in the smaller cities in the group of from 10,000 to 25,000 is affected by the question of volunteer fire departments. In some cases the chief of the volunteer fire department, for example, receives a nominal salary of a few hundred dollars. The salary figures are also affected by the fact that the same named position may not in the various cities represent the same actual work or responsibilities. The most striking example of this is in the column of salaries of secretaries, the importance of this position appearing to vary from that of a purely clerical nature to a position of real responsibility, with commensurate salary, in some of the larger places.

Roofing Ordinance Upheld in N. J.

In sustaining the conviction of one Irvy Meyers, a coal and lumber dealer of Hawthorne, N. J., for placing a wooden shingle roof on a building owned by him, the New Jersey Supreme Court recently established the constitutionality of fire-resistive roof ordinances in that state. The case is of interest because it establishes the fact that even the better grade of red cedar shingle is, in the opinion of the law, combustible.

The Building Code of the Borough of Hawthorne adopted in 1916 contains the following section:

"16. Every building hereafter erected within the corporate limits shall have an incombustible roof covering and no existing wooden shingle roof if damaged more than 25% shall be renewed with other than incombustible roof covering."

In spite of this provision and in the face of warnings from the building inspector, Mr. Meyers applied a certain brand of red cedar shingles to the roof of his dwelling. As a result Mr. Meyers was brought to trial before the Borough Recorder. In his defense his counsel argued that the ordinance was confiscatory and discriminating, it being implied that these red cedar shingles were as fire retarding as the shingles required by the building inspector. The building inspector testified that it was his practice to accept only shingles bearing the label of Underwriters' Laboratories. According to a newspaper account of the trial Mr. Charles E. Marsh, an agent of the Red Cedar Shingle Bureau, testifying in defense of Mr. Meyers, was forced on cross examination by the Borough counsel to admit

that the type of wooden shingles used by Mr. Meyers were combustible.

As a result of this trial Mr. Meyers was convicted. He appealed his case to the Supreme Court of New Jersey which, after hearing, sustained the judgment of the lower court. In so doing Justices Trenchard, Katzenbach and Lloyd handed down an opinion, reproduced in substance below, which clearly indicates the legal reaction to fire-resistive roof ordinances.

The evidence established that the prosecutor (Meyers) replaced an old shingle roof with an entire new one, also of shingles, on his residence at 196 Lafayette Avenue in Hawthorne. The house on which the roof was placed was in a section of the borough where the houses averaged one hundred feet apart. The borough contains a population of 7,765 and has an area of 13½ square miles, but only a small congested section was affected by the ordinance. The shingles used were known as a perfection red shingle which the evidence showed was combustible, and this fact is not disputed.

The borough's authority to pass the ordinance is rested by the defendants on the Home Rule Act of 1917, page 354, which in sub-division N of paragraph 1 of article XIV authorizes the municipality "to regulate and control the construction, erection, alteration and repair of buildings and structures of every kind."

The sufficiency of the statutes to justify the present proceeding and the ordinance upon which it rests is disputed by the prosecutor who cites cases from other states to sustain his contention. They are on different statutes, however, which do not seem to cover repairs.

We think sub-division N by its language covers the situation here presented. It is evidently intended to confer on all municipalities the power to protect the lives and property of their people against the ever imminent danger of fire, and, within reasonable limits, to reduce this danger to the lowest point consistent with the dominion reserved to the individual owner over his property under the constitution. That the state has the power to limit the replacement of roofs with combustible materials in built up communities we think clear. The roof is the one point of all buildings where ignition from fires is most likely to occur. If inflammable the danger is greatly magnified. Sparks lie there and eventually burst into flames. From the walls they fall to the ground and die. It is common knowledge that pre-eminently from this source great conflagrations spread.

Having the power the state could confer a like power on the municipal authorities and as stated we think it has done so.

The foregoing facts and reasoning lead us also to the conclusion that the ordinance is not unreasonable or discriminatory. The houses in the section set out in the fire zone are so near together as to justify special provision for their protection and the prosecutor has failed to establish that there is discrimination in fixing this zone.

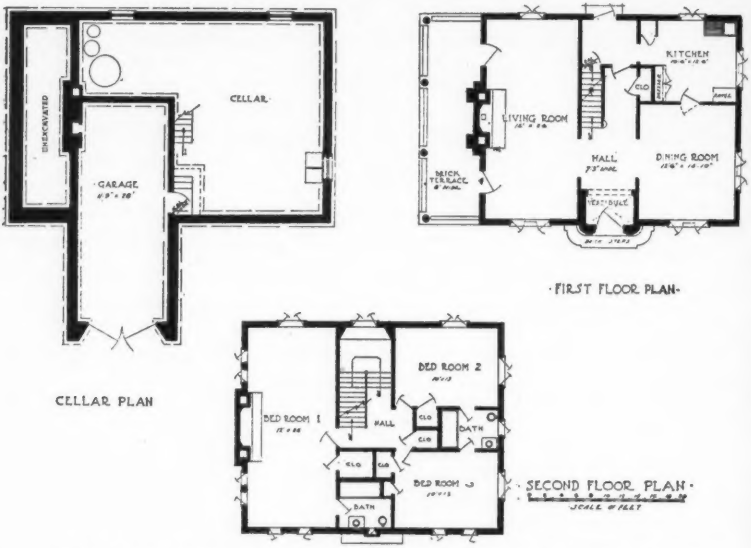
The prosecutor was convicted and sentenced to the maximum fine. Of this he cannot complain legally, nor actually, as we think, inasmuch as he had been cautioned by the authorities against proceeding with the use of the shingles with which the roof was recovered.

A Fire-Resistive Dwelling House.

By R. S. Tilden, Consulting Engineer.

The house shown in the accompanying illustrations, built at Great Neck, Long Island, N. Y., was planned and erected to provide a practical demonstration of the possibilities of constructing small houses of permanent fire-resisting materials, and to determine whether the cost could not be kept within that required for usually less costly types of good construction employed for similar dwellings. The production of low cost individual houses has usually been accomplished by reducing the area to a minimum and the selection of materials and building methods that lowered the first cost but increased the maintenance cost and depreciation factor so that the ultimate cost equalled or exceeded the first cost of good construction.

After determining the type and plan of the house to be built, it was decided that any material used must meet the following requirements:— it must be structurally good; sufficiently flexible to permit of good design;



Floor plans of the house described showing plans for garage in cellar. Kalamein doors between the garage and cellar and at the head of the cellar stairs, serve as firestops at these openings.

Extracted from an article in the *American Architect*.

J. T. Briggs, Architect, Brick Homes Co., Inc., Owners.

A general view of the dwelling herein described, before landscape work had been completed. Space for garage is provided in the basement.

require little or no upkeep; be fire-safe; and moderate in price. In formulating these rules for guidance, an attempt was made to secure a reasonable balance between cost, quality and permanence or maintenance features.

The selection of materials based upon these rules has been proven fundamentally sound, and any changes made in subsequent buildings would probably be in minor details rather than in any radical change in the selection of materials, although there are undoubtedly other materials that could be used to equal advantage. A different selection of material would very likely be made in other localities where building customs and costs varied from those found on Long Island.

Common brick was decided upon as being the most suitable material for the exterior. Brick walls were, therefore, used from the concrete footings to the roof, in general 12 in. in thickness below grade, and 8 in. in thickness above grade.

The floor construction was composed of 6 in. light section structural steel members upon which was poured a reinforced 2 in. gypsum arch over a gypsum board form. Wood sleepers as nailing for the finished wood floors were imbedded in the floor arch. Roof construction was of similar

materials except that the gypsum was pre-cast and the sleepers omitted. Roofing felt was applied directly over the gypsum and the slate fastened directly to it, using cut copper nails. Gutters, leaders, and flashings are of copper; the leaders being connected to dry wells were deemed sufficient provision for drainage, due to the character of the soil.

Interior partitions are non-bearing and built of 3 in. gypsum block except where bathroom tiling required the use of cement mortar, and then 3 in. hollow tile blocks were used. All piping was concealed in furred spaces or within the partition construction. Bucks of wood provided temporary support for partitions and served to later secure the doors and trim. Plaster was of three coat work throughout, placed directly on the partition tile and on metal lath for ceilings and exterior walls. The latter were furred before lathing.

All stairs were built of iron. Basement stairs are of the open riser type with checkered plate treads. From the first floor up, steel risers were used and the steel treads covered with 1¼ in. oak treads bolted through the steel. Wooden handrails were used on stair rails with balusters of plain and twisted square bars attached to a steel facia. It will be noted that woodwork was reduced to a minimum and entered into the building as a finishing material only, with the exceptions of bucks and sleepers.

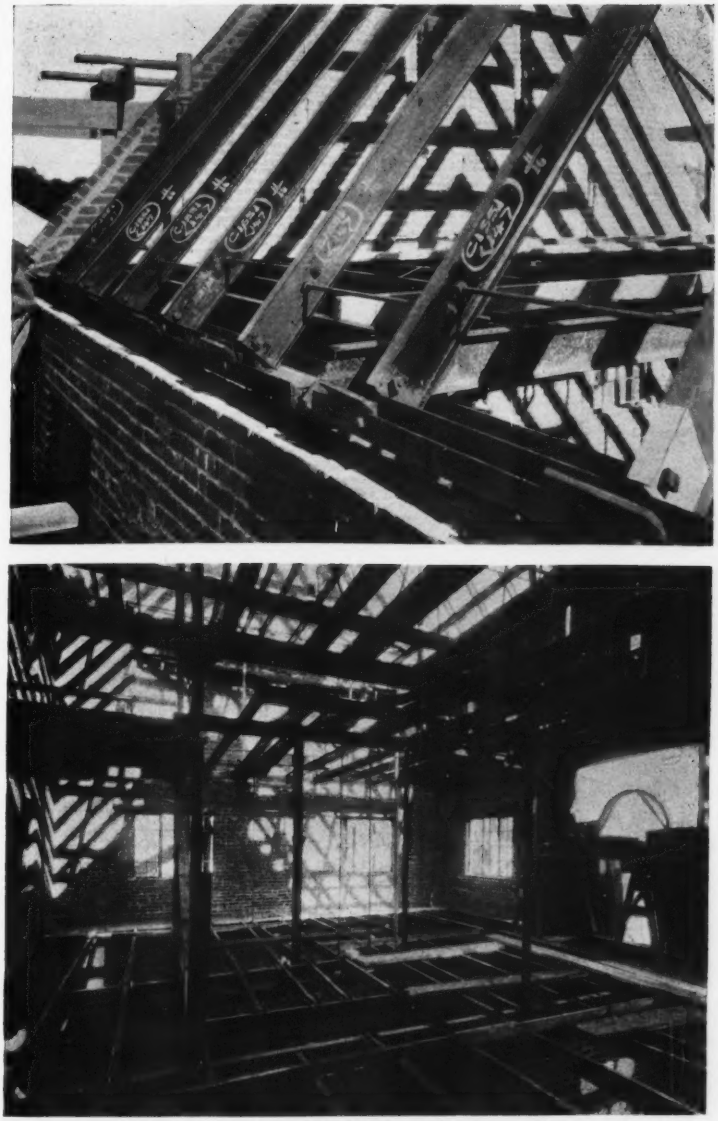
Mr Tilden furnishes the following data on costs, comparing the estimated cost of the usual frame combustible construction with the actual cost of the fire-resistive construction used:

Floors and Roof (excepting finish flooring and roofing)			
Frame	$1,510.	Steel Framing and Floor Arches (including sleepers).....	$1,766.
Partitions			
Frame (unlathed)	284.	Gypsum Block	528.
Inside Wall Finish			
Wood Lath and Plaster..	750.	Plaster over Gypsum Partitions	480.

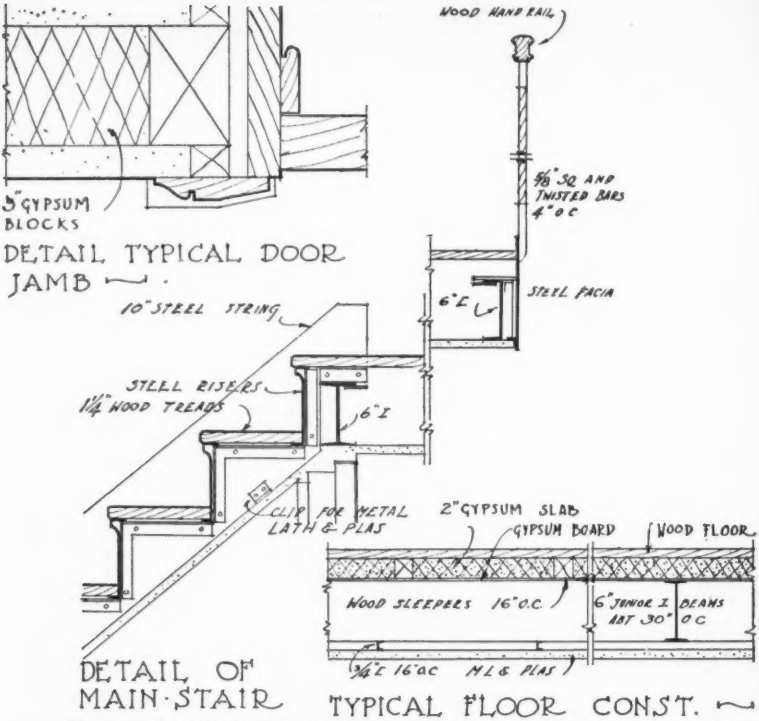
In explanation of this table Mr. Tilden says:

"We made no estimate of the cost of frame construction, but our average figures from a considerable number of jobs show that the cost of brick dwellings over frame, other things being equal, approximates 5% of the entire building cost. I have included the floor and roof framing, together with the arches and sleepers as a single item as our contracts were made on that basis. The partition framing has been estimated alone, as compared to gypsum block, for the reason that gypsum block requires no lath of any description. The cost of the interior wall finish for frame construction, or in other words, lath and plaster, was compared with the cost of the plastering only, no lath being required in the gypsum partitions.

"These are the principal items in which differences occur, and while these figures would show an apparent extra cost of about two hundred dollars, rough hardware, including stirrup irons, nails, bolts, etc., were not included in the estimates on frame construction, and would of course reduce this somewhat. The final figure of something under $200 would be sufficient to cover the extra cost of a building the actual construction cost of which was approximately $22,000, or in other words something less than 1% premium for a structure in which maintenance has been to all practical purposes eliminated."



Two views showing how the light section steel I-beams are used (above) in roof and (below) in interior and floor construction. The wooden stringers are temporary, used to facilitate spacing of the beams only.



Construction details showing how wood trim is used in connection with the fire-resistive floor and wall construction.

Kalamein doors are used at openings between the garage and basement, and at the head of the cellar stair. The garage portion is completely enclosed by a solid wall of brick extending up to the first floor arch.

In addition to being incombustible the materials used in the structure are practically "decay proof." The slight changes in the steel due to variation in temperature would not be sufficient to cause damage to either arches or plaster. The brick walls will require no upkeep. The partitions are free from the "settlement crack" nuisance, stairs will not squeak, slate has a long record of successful service as a roofing material, and probably the only item needing periodical maintenance will be exterior painting of the steel sash and wooden doors.

The actual cost was very close to the original estimate, and practically the same as the estimate based on what is generally accepted as first-class residential construction. Some items, naturally, were more costly than those which they replaced, but this was largely overcome by savings in others.

It is thought that with the experience gained from this first job, that a duplicate could probably be built at a saving of from 8% to 10%.

From the beginning to the completion, it was evident that dwellings of this type must be very carefully planned for all trades. It is not sufficient, for example, to indicate a house line and let the plumber work out its location and direction. It must be done for him and done before construction is actually started. Supervision must have careful attention and be done by one whose construction experience is broad in both methods and materials. The average subcontractor on suburban residential work may be willing, but his field has been too narrow to appreciate the possible difficulties of the trades associated with him in the construction of permanent fire-safe dwellings.

Use of Fire-Safe Building Material Increases.

(Reprinted from the *National Lumber Bulletin.*)

The recent publication of 1925 reports of the U. S. Census Bureau gives basis for latest percentages in the following table of 15-year comparisons of production of building materials which was first published as a part of the report of the Secretary and Manager of the National Lumber Manufacturers Association to the Board of Directors in December, 1925.

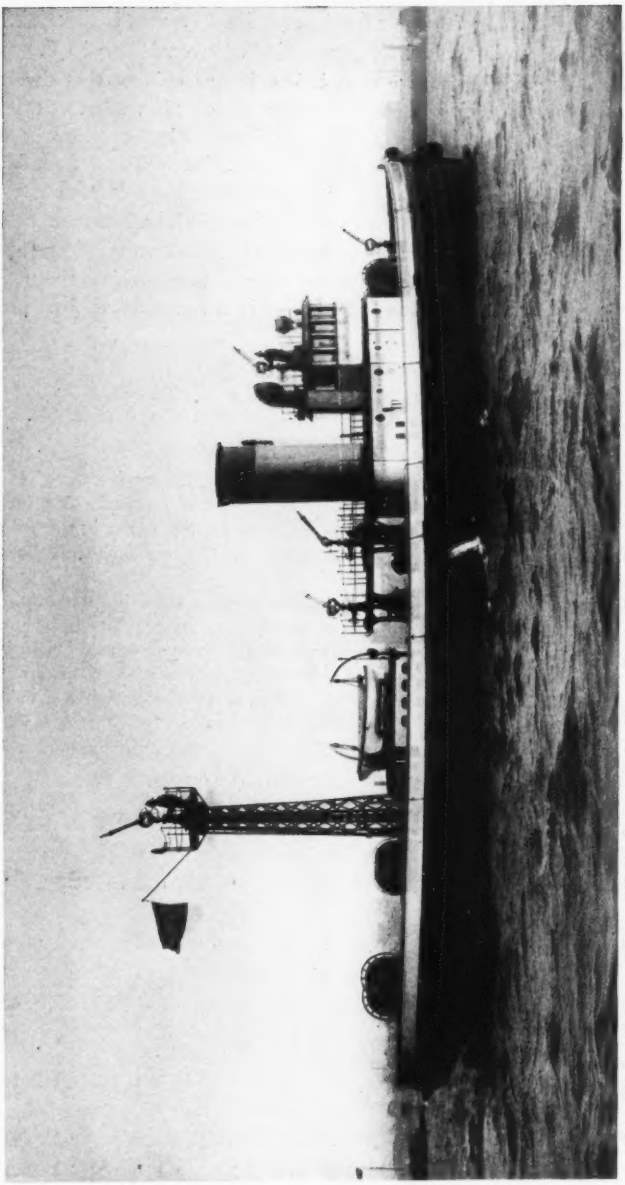
Of the items listed, Portland cement, face brick, steel plates, hollow building tile and gypsum show increases comparable or nearly comparable with the growth of building activities. Lumber has not even kept pace with mere population increase; in fact, has fallen behind at every point. Wall boards, new roofing materials and many other widely advertised and efficiently promoted building substitutes, unknown in 1909 or manufactured in too small volume to be recorded, have also helped to fill the gap between the increase in building and the decrease shown by the lumber items.

SUPPLY AND DEMAND—1909-1925.

Production 1909 = 100.

Supply (Building Materials)— **Annual Production**	1909	1914	1919	1921	1923	1925
Softwood lumber	100%	86.8%	80.9%	65.5%	92.2%	93.5%
Hardwood lumber	100	74.8	67.3	45.0	59.0	62.5
Wood shingles	100	....	61.7	45.9	50.4	49.3
Wood lath	100	....	46.6	53.2	90.0	85.4
Common brick	100	73.0	48.5	45.4	74.4	91.6
Face brick	100	99.3	96.9	107.0	236.6	259.7[2]
Portland Cement	100	135.8	124.3	152.1	211.5	248.0
Hollow building tile	100	179.5	191.4	165.5	308.9	347.4
Structural steel shapes	100	89.3	114.9	55.9	149.6	158.4
Iron and steel plates	100	111.5	174.1	100.6	224.3	231.6
Gypsum	100	....	107.4	128.3	211.0	252.0
Demand (Building Materials)—						
Contracts awarded, 27 states	100	89.4	162.2[1]	144.8[1]	201.2[1]	303.0[1]
Population, U. S.	100	108.0	115.8	119.6	123.2	127.2

[1]Reduced to basis of 1913 construction costs. [2]1924.



The "John Purroy Mitchel," fireboat of the New York Fire Department cited by Mr. Colson as typical of the steam-driven type. Capacity 9000 g.p.m. at 150 lbs. pressure.

Fireboats—Steam and Diesel Electric.

Following the demonstration of the Port Houston, the new Diesel electric fireboat built for Houston, Texas, during the 1926 annual meeting of the N.F.P.A., an article describing this vessel was published in the July, 1926, QUARTERLY (Vol. 20, No. 1, page 51). This article, taken from the June issue of *Motorship* and published by the courtesy of the editor of that publication, discussed at some length the merits of this fireboat which is the first vessel of this type constructed, the steam fireboat representing the type which has heretofore predominated. A protest was received to the effect that this article in the July QUARTERLY might lead those who had not made a special study of this subject to overlook consideration of the older steam type fireboat when taking up this subject.

In order to give fair and impartial consideration to the advocates of both of these types of vessel there are printed herewith articles discussing at length the advantages of the steam and the Diesel electric types respectively. The article on steam fireboats, the first of these two contributions received by the editor of the QUARTERLY, is written by Member Edward A. Colson, who is connected with a manufacturer of steam equipment. The article on the Diesel electric type is written by Messrs. Cox and Thau, the designers of the *Port Houston* and her equipment. While it is not usual in the columns of the QUARTERLY to print material of a controversial nature, it has been thought desirable in this instance to give equal space to the two articles printing in full the material contributed by the respective advocates of the two types of vessel.

Steam Fireboats.

By Edward A. Colson.
(Member N.F.P.A.)

Several cities, at present, are discussing the building of new fireboats and, undoubtedly, as a result of the action of Houston, Texas, these discussions will include a consideration of Diesel electric. Inasmuch as the Diesel electric fireboat is the latest design of this type of vessel and, due to her novelty, much is said concerning her, she is kept pretty constantly in the public eye.

The article on the *Port Houston* in the July QUARTERLY, taken from the June issue of *Motorship*, makes very interesting reading, but might lead an incautious reader to the conclusion, apparently desired by the author, that the question of the "expensive" steam fireboat is settled once and for all through its replacement by the more modern and "economical" Diesel electric type.

Inasmuch as, in the nature of things, a fireboat lies idle the greater part of the time, and hence is a very expensive necessary evil, it behooves those who are responsible to the taxpayers for the purchase of new equipment to examine closely into the different types so that the least money will be expended to accomplish the desired results.

The first thought in connection with a new fireboat is, how much water must be pumped at effective pressure?

Then, how best, and with what type machinery shall this be done?

How much will the total first cost be?

How much will be the operating cost?

The *Motorship* article on the *Port Houston* says in part:

" . . . and by the realization that she incorporates greater efficiency as a fire-fighting unit than any piece of floating fire equipment that has yet been built in the world. Not only does she perform all that could be accomplished with a steam fireboat or with a steam-electric fireboat, but she achieves it also at a greatly reduced cost, notwithstanding the slightly increased capital investment which she represents. There are, of course, no standby losses in her and yet she is instantly available to respond to any fire call and can get under way as fast as the crew can get to its stations."

No figures are given here relative to the various points of superiority of the Diesel electric over turbo electric or straight steam, but in articles on this boat, other than that quoted here, figures are given and of such a character that the incautious reader is led further to false conclusions.

There is no question that electric machinery is in the main more economical than straight steam, more flexible in its adaptation and that it has brought up the mechanical efficiency of our age. The question in hand is not electrical machinery *per se* but the combination of electrical machinery with high speed light weight Diesel engines in fireboats and the costs resulting from such installations.

A careful study, from all angles, of the Diesel electric and steam fireboat equipment will bring out facts that cannot be dismissed with a wave of the hand. For the sake of those who find it necessary to examine into these matters let us compare the *Port Houston* with a modern oil burning steam fireboat of about the same capacity. For this purpose, let us take the New York Fireboat *John Purroy Mitchel* whose water capacity is nearest to that of the *Port Houston*. In order to bring out all the facts we will also look into certain phases in connection with the operation of fireboats of other cities.

The contract price for the *Port Houston* was $273,000 f.o.b. shipyard, or $279,500 delivered at Houston, Texas. The total cost to the owners when completely equipped amounted to approximately $314,000 This means an additional expenditure of $34,500 over her delivered price for fire fighting equipment, spares, tools, etc.

JOHN PURROY MITCHEL	*PORT HOUSTON*
Steam propulsion and pumps.	Diesel electric propulsion and pumps.
133′ 7½″ Length overall.	125′ 10″ Length overall.
28′ 8½″ Extreme beam.	27′ 0″ Beam.
9′ 6″ Mean draft.	8′ 6″ Draft.
Two pumps.	Two pumps.
9,000 Gallons per minute at 150 lbs. pressure.	7,000 Gallons per minute at 150 lbs. pressure.
7,200 Gallons per minute at 175 lbs. pressure.	.....
4,500 Gallons per minute at 300 lbs. pressure.	3,500 Gallons per minute at 300 lbs. pressure.
Total cost, completely equipped, approximately $230,000.[1]	Total cost, completely equipped, approximately $314,000.

It is not clear whether the Diesel electric type of fireboat requires so much more fire fighting equipment than the steam type, or that those responsible for her design, building and equipment were at fault in drawing up the original specifications. However, we fail to see how $34,500 could be expended on fire fighting equipment, especially as no such expenditures are entered into by other cities whose fireboats, almost double the capacity, have been outfitted for a sum of about $6,000 over the contract price.

Here we have an oil burning steam fireboat with a capacity of 9,000 gallons per minute costing $230,000 and a Diesel electric fireboat with a capacity of 7,000 gallons per minute costing $314,000.

What justifies the added initial cost for the fireboat with the lower capacity?

Costs.

The *Port Houston* article contains the statement: "achieves it also at a greatly reduced cost." This statement is based undoubtedly on the assumption that the Diesel electric plant requires about half the fuel per horsepower hour that is used by the steam plant. This would hold very closely with apparatus such as we are considering. However, it must be remembered that Diesel oil is generally 25% to 40% higher in price than boiler oil.

When it is considered, however, that the fireboat works but seldom, the fuel saving during fire fighting is relatively insignificant and need not be taken into consideration, especially in view of other unfavorable conditions that will be brought out later on.

The fuel saving of the Diesel electric over the steam fireboat for fire fighting purposes is potential rather than real and a constant succession of fires would be necessary to show this saving.

The saving of fuel, however, is due to standby losses which, in the nature of things, will be higher on the steam fireboat than on the Diesel

[1] Contract price 1921, $222,000. Cost 1925 (to compare with Diesel electric fireboat), $230,000.

electric fireboat. The *John Purroy Mitchel* burns 33⅓ barrels of oil per week at a cost of approximately $60 (current price of boiler oil, $1.75 per barrel). This fuel is consumed in maintaining a full head of steam, turning over the main engines, etc., and for the operation of bilge and sanitary pumps, lighting, heating, etc. The latter items will be more or less common to both types of boats, the fuel consumption, however, on the Diesel electric for these purposes will be very much less than for the steam boat.

Flexibility.

With the steam fireboat any portion of her power may be diverted at any time from one pump to another or from the pumps to the main engine or vice versa. This is not possible with the arrangement of Diesel electric equipment on the *Port Houston* where the output from the main generating units must be all used by the pumps or all used on the propulsion motors.

The builders of the equipment on the *Port Houston* say, however, that by adding more machinery to the present equipment it is possible to achieve a flexibility very nearly equal to that of the steam boat. This, however, would be at a very material increase in cost and weight. In fact, the cost and weight would probably be double. With the increased machinery there would be a demand for more space to accommodate it. Inasmuch as this is not available in the *Port Houston* a larger hull would be necessary, thus adding to the cost over and above the cost of the added equipment. If the specified fueling periods are to be maintained the added machinery would demand a larger bunker space.

Maneuvering.

The fireboat does not necessarily tie up at a pier when fighting a fire, but is often obliged to lie off the pier or in the stream and is frequently called upon to tow out a blazing vessel. Under such conditions tide, wind, thrust of nozzles, etc., demand considerable power to maintain the position of the vessel; and the towing out of a blazing vessel, maintaining at the same time full pumping capacity, demands a very considerable portion of the full power of the main engine.

The Diesel electric fireboat, with her greatly reduced propulsive power while pumping at her maximum capacity, would be at a disadvantage under these conditions, but the steam fireboat by raising the evaporative rate on the boilers would be able to keep her pumps going at full capacity and still have very nearly full power on her main engines with which to maneuver.

Efficiency.

Efficiency is a ratio between the work to be done and the energy applied, and so far as water pumped per pound of fuel is concerned the efficiency of the Diesel electric plant will be greater than that of the steam

plant, but when, as shown later on, certain other features far outweigh this efficiency, the people who have to foot the bill will be quite willing to accept the less efficient steam pumps.

Relative Costs.

In the paragraph quoted "the increased capital investment" in the Diesel electric plant over that of steam is characterized as "slight". Let us refer back to the cost of this boat compared with the steam fireboat, bearing in mind at all times that the steam fireboat is more powerful and with a greater fire fighting capacity in terms of gallons per minute.

The capital invested in the *Port Houston* is $314,000. This represents the entire first cost to her owners. Compared to this the *John Purroy Mitchel* cost $230,000. Here is a difference of $84,000. Interest, insurance and depreciation (totalling 15%) on this difference in first cost represents a charge to her owners of $12,600 annually.

This amount more than offsets the favorable advantage to the Diesel electric equipment in the matter of fuel. The annual bill to New York City for fuel for the *John Purroy Mitchel* has averaged over a period of three years approximately $5,200 per year. The annual fuel bill for the 10,000 gallon fireboats in Philadelphia is approximately $6,000 per year. It is to be noted that the annual interest charges on the increased capital investment in the Diesel electric plant over that of steam would buy more than two years' fuel supply for the steam fireboats.

The total investment in the fireboat is the amount on which the interest charges must be placed and not the cost of any one particular part of her equipment. It is safe to say that fireboats, generally, work not over 1% of the time and in many instances far less than 1% of the time. The fireboat, however, is very necessary and must be maintained for our protection in spite of the fact that she works so seldom. Where lies the economy in investing so much money that the possession of a Diesel electric fireboat leads to such a penalty as is shown above?

One of the points of so-called superiority of the Diesel electric over the steam fireboat is the matter of pilot house control. Pilot house control is not exclusively the property of the Diesel electric equipment but has to do with the electrical part of this equipment. Pilot house control has been used for years antedating Diesel electric equipment and is used with turbo-electric machinery.

The installation, however, of turbo-electric machinery in a fireboat, from the standpoint of first cost, is as inadvisable as the installation of Diesel electric machinery.

Cost of Crews.

Conditions under which the engineer force of fireboats work vary in different cities, but in the main, the cost of engine and boiler room crews

on a steam fireboat is not higher than the cost of the crew that operates the *Port Houston*. We are not here considering the deck force or the hose crew. The deck force and hose crew will be the same for either type of boat depending on the size of the boat and the number of outlets to be handled at a fire.

JOHN PURROY MITCHEL		*PORT HOUSTON*	
4 Engineers @ $2,920 per yr. =	$11,680	2 Engineers @ $200 per mo. =	$4,800
6 Stokers @ $7.50 per day =	16,425	2 Asst. Engrs. @ $185 per mo. =	4,440
	$28,105		$9,240

The peculiar condition shown above does not obtain in any other city operating fireboats and it cannot be claimed that high operating costs are inherent in the steam fireboat. For example, Philadelphia has two 10,000-gallon fireboats, the cost for engine and boiler room force for each of which is $10,700 per year. Baltimore operates three steam fireboats whose engine and boiler room force costs the city $7,950 per boat per year.

A like condition surrounds the operation of fireboats in Boston, San Francisco, etc. This shows that a large high priced crew is not necessary to the operation of a steam fireboat, and that, if such a large high priced crew is maintained, it is not because the boat is steam driven.

Weights and Costs.

The steam fireboat is equipped with standard weight reciprocating engines for propulsion and standard weight water tube boilers. No attempt has been made to cut weights, but on the basis of total brake horsepower, and total cost of completed fireboat, in each case, the Diesel electric equipment weighs and costs more per B.H.P. than the steam equipment; in fact the cost of the Diesel electric equipment per B.H.P. is over double that of the steam equipment. However, in the matter of costs, the tax-payers are interested mainly in the total cost of the boat, as reflected in the bond issue to provide for the boat.

Maintenance.

The *John Purroy Mitchel* has had no major repairs in four years of service, the only expense being annual overhaul and painting, such as any vessel receives. Steam fireboats built over eighteen years ago, with a capacity much greater than that of the Diesel electric, are still working at this time with their original equipment and at their same capacity.

It is questionable whether the light weight, high speed Diesel equipment will be in the same shape after a period far less than eighteen years.

As a matter of fact, during the past three or four years, several Diesel electric installations have been made which have been a source of grief and expense to their owners.

There is no reason to expect that this type of machinery will be any more reliable or less liable to breakdown when installed in a fireboat than in any other type craft.

The fireboat, however, as pointed out, works so seldom that this feature of unreliability may not enter in. Times do occur, however, when the fireboat is called upon to pump full capacity for long continued periods and it would be a very serious matter to have the expensive Diesel electric fireboat break down just when she is called upon to check a disastrous fire along the water front.

The tax-payers who have allowed themselves to be persuaded into purchasing a fireboat of this type, costing so much more than a steam fireboat of greater capacity, will be in no condition when this boat fails at a critical time, to discuss dispassionately the breaking of crank shafts, loss of cylinder liners or some other such feature. It has been pointed out that the *Port Houston* is equipped with twin screws, a feature seldom incorporated in other fireboats. This is a condition made necessary by the type of machinery installed and the electrical set up, two pump motors and two propulsion motors, and could not with this arrangement have been avoided.

The description of the *Port Houston* points out a multiplicity of outlets along the rail. It is to be noted that the number of streams available have no bearing on the fireboat unless these streams can be directed upon a fire, and, if so directed, they will each require a hoseman; that is, each outlet will require one hoseman to operate. It must be remembered also that *effective* fire fighting will be done with a few streams at relatively high pressure, and while to the uninitiated, a fireboat throwing a multitude of streams of water may make a fine picture, it must not be lost sight of that these streams are at a low pressure and of no great value in real fire fighting.

The greater cost of the Diesel electric fireboat with the several features of questionable value is really not justifiable; in fact to put such an excessive amount of money into this type of boat is like going out to shoot rabbits with a six-inch field gun.

This whole comparison has been between boats of different capacities, the smaller boat with the lower capacity costing far more than the larger boat with the high capacity. Those who have made a complete analysis of various types of equipment and costs say that to increase the capacity of the *Port Houston* to that of the *John Purroy Mitchel,* that is, from 7,000 gallons per minute to 9,000 gallons per minute, the *Port Houston* would cost 60% to 80% more than the steam fireboat. This statement is based on very close observations in their analyses that the cost of the

Diesel electric fireboat would go up in proportion to its pumping capacity.[1]

The following table, giving comparative costs of steam and Diesel electric fireboats, will illustrate very clearly how such conclusions are arrived at.

Name	Contract Price	Cost Complete	Capacity GPM 150 lbs. Pressure	Cost Complete per 1000 GPM 150 lbs. Pressure	Cost Complete per BPH available simultaneously
Blankenburg (Philadelphia)	$249,500	$255,000	12,500	$20,400	$118.05
Moore (Philadelphia)	212,490	218,000	12,800	17,440	100.92
Deluge (New Orleans)	264,474	264,474	14,000	18,891	92.79
Mitchel (New York)	222,000	230,000	9,000	25,556	124.32
Port Houston	273,000	314,000	7,000	44,857	341.30

The following table is composed of costs estimated by authorities on the subject and the figures are the result of studies made in connection with actual boats, also some tentative studies. It will be seen by comparing with the above table that these figures follow very closely.

Comparative Costs of Fireboats.[2]

A 6,000 GALLON FIREBOAT

120′x25′x13′ 0″
1500 Horsepower
150 lbs. pressure of water
Speed—13 miles

Diesel Electric	$275,000
Diesel	$250,000
Steam	$185,000
Steam—225 lbs. water pressure	$195,000

A 7,500 GALLON FIREBOAT

125′x26′x13′ 6″
2000 Horsepower
150 lbs. pressure of water
Speed—13½ miles

Diesel Electric	$325,000
Diesel	$285,000
Steam	$205,000
Steam—225 lbs. water pressure	$215,000

A 9,000 GALLON FIREBOAT

130′x28′x14′ 0″
2500 Horsepower
150 lbs. pressure of water
Speed—14 miles

Diesel Electric	$425,000
Diesel	weights are excessive
Steam	$225,000
Steam—225 lbs. water pressure	$240,000

AN 11,000 GALLON FIREBOAT

136′x29′x15′ 0″
2700 Horsepower
150 lbs. pressure of water
Speed—15 miles

Diesel Electric	$450,000
Diesel	weights are excessive
Steam	$260,000
Steam—225 lbs. water pressure	$275,000

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[1] *Marine Engineering & Shipping Age*, April, 1926, "Steam vs. Diesel or Diesel Electric Power for Fire Boats," by Howard E. Cornell. In comparing the cost of a Diesel electric fireboat with a steam fireboat of about 10,000 gallons capacity this article states: "In comparison with the above the cost of a Diesel electric that would equal it in every respect would be from 60 to 80 per cent higher. This additional cost would not be justified from any standpoint except, perhaps, personal preference."

[2] These costs refer to boats completely equipped.

The Diesel Electric Fireboat.

By Daniel H. Cox and W. E. Thau.

Until recently, steam equipment alone was used for the pumping and propelling equipment of fireboats. Lately, however, prompted undoubtedly by the improvements introduced into fire truck equipment and the developments in marine propulsive plants, other means of power generation and utilization have made their appearance in the fireboat. In 1908, Chicago built and put in service two electrically operated fireboats, with steam turbines as prime movers. This form has, to the writers' knowledge, not been repeated. Los Angeles and Jacksonville have built and put in service, fireboats utilizing gasoline engines for pumping and propulsion.

The Harris County Houston Ship Channel Navigation District Commission has built and put in service in 1926 a fireboat containing all the latest refinements in fire-fighting equipment. Unlike her predecessors, this fireboat, *Port Houston,* utilizes the Diesel electric system for driving the pumps and propellers. No expense was spared in making the *Port Houston* a very effective fire fighting machine. While she does not have as great capacity as some of the fireboats of other cities, such as the *Deluge,* New Orleans; *J. Hampton Moore,* Philadelphia; *David Campbell,* Portland, Oregon; *John Purroy Mitchel,* New York; *W. S. Gratton,* Buffalo; *Torrent* and *Deluge,* Baltimore; her capacity is adequate for the service she is required to render. In the way of fire fighting equipment, she has certain features not commonly found on other fireboats, at least not collectively so. These features, as pointed out below, add measureably to the relative cost as a complete boat. The additional cost is justified.

The *Port Houston* was designed by Cox and Stevens, built by the Bethlehem Shipbuilding Company, and equipped with Diesel-electric pump and propeller drive consisting of Winton Diesel engines, Westinghouse electrical equipment and Worthington pumps. The vessel is 125 ft. 10 in. overall in length; 27 ft. in beam; 8 ft. 6 in. in draft, and of steel construction throughout. There is one main tower which can be raised or lowered, three other fire stations, eight rail nozzles permanently installed, and hose connections at various positions along the rail and at different heights, thus providing a most effective and flexible combination through a total of 39 outlets. As a matter of interest, the tower, the three stations and the eight permanent rail nozzles, will allow 13 streams to be thrown from the boat without the use of one inch of hose. This arrangement permits of the utmost flexibility, allowing streams to be directed from both sides and from each end of the boat, and makes it possible for those in charge to handle a fire of any description to the best possible advantage.

Naturally all the outlets will never be in use simultaneously except for exhibition purposes.

There are many other features in design and equipment incorporated in the *Port Houston*, which represent more expense than is usually put into fireboats. Twin screws are used for the purpose of facilitating maneuvering in restricted waters and thus enhancing the effectiveness of the boat. The Diesel electric system of drive could be used for either single or twin screws, the twin screw arrangement involving an increase in expense not required by reason of the Diesel electric drive. In an analysis of expense, it is important to note that the introduction of complete boat costs into a comparison of types of pumping and propelling machinery, except only in so far as the latter affect the cost of the boat, is fundamentally wrong and absurd; yet some recently published comparisons abound in such camouflage practice.

The power equipment of the *Port Houston* consists of the following:

Two main generating units, each consisting of a 500 H.P., 6 cylinder, 4 cycle, Diesel engine, driving a 350 KW., 425 R.P.M., 500 volt main generator, and a 25 KW., 125 volt, direct connected exciter.

One auxiliary generating set consisting of one 165 H.P., 6 cylinder, 4 cycle, Diesel engine, driving two 50 KW. 425 R.P.M., 270 volt generators.

One 10 KW., 125 volt, 720 R.P.M., exciter driven from the above engine.

Two 410 H.P., 500 volt, 1750 R.P.M., 3500 G.P.M., 150 lb., fire pumps.[1]

Two 360 H.P., 500 volt, 265 R.P.M., propelling motors.

One 10 KW., A.C.-D.C., motor-generator set for furnishing power from shore circuits when alongside the pier.

One complete switching and control equipment for the main and auxiliary machinery.

One pilot house control station for the control of the propelling motors.

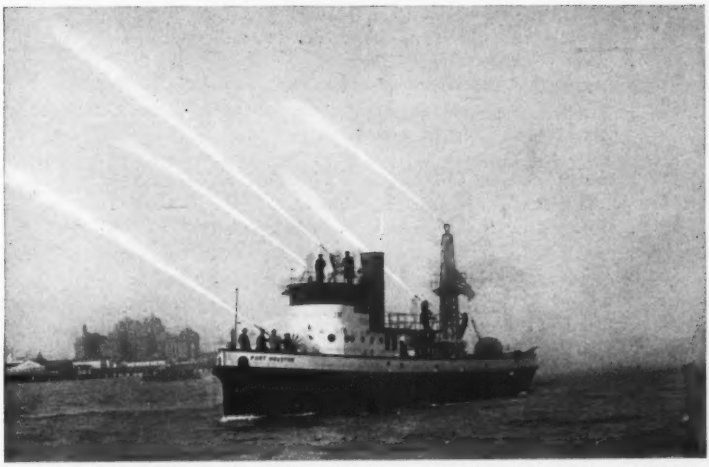
One engine room control station for control of the propelling motors and fire pumps.

All of the above machinery, with the exception of the shore power set is of the direct current type arranged for variable voltage control.

The electrical connections are such that the two 350 KW. generators supply power to the propellers while en route to the fire, and to the pump motors when fighting the fire. When in action at the fire, the propelling motors are transferred to the two 50 KW. generators driven by the auxiliary engine and in this manner ample power is provided for any maneuvering condition. A further flexibility in the electrical system provides for operating either pump motor or propelling motor from either of the 350 KW. generators. With the above system for interconnection of power, it is seen that sufficient flexibility is provided to take care of all conditions encountered by a fireboat.

Reliability is an important factor in the selection of power plant and pumping equipment for a fireboat. The statement has been made that

[1] These can be arranged in series to give 3500 G.P.M. at 300 lbs. pressure.



The "Port Houston" during the demonstration before the N.F.P.A. annual meeting at Atlantic City in May, 1926.

several Diesel electric installations made during the past three or four years have been a source of grief and expense to their owners. Probably no one has followed the performance and developments of Diesel electric installations more closely than the authors of this article, and to their knowledge, there have been only two examples of installations which have been the cause of any concern to their owners. In both cases, the trouble has been with the engines, and it is significant to note that the permanent corrections made place the nature of the troubles outside the category of inherent. If one were so inclined, one would not find it difficult to list scores of serious boiler and steam machinery casualties.

An analysis of actual performance data relative to fifteen representative steam fireboats of eleven cities shows the following facts and service conditions:

(1) Average total pumping capacity—8100 G.P.M. at 164 lbs. pressure.
(2) Average total pump drive brake H.P.—1120.
(3) Average total propeller shaft H.P.—906.
(4) Average total maximum boiler capacity—36,000 lbs. steam per hour.
(5) Average total steam pressure—200 lbs. per sq. in.
(6) Average total steam for pumps at full capacity, 30,000 lbs. per hour.
(7) Average total remaining steam for propeller drive, 6000 lbs. per hour.
(8) Average total horsepower available for propulsion when pumps are operating at full capacity—230.
(9) Reducing (8) to per cent of (3)—25.5%.
(10) Actual per cent power available for propellers when operating pumps at full capacity varies from 0 to approximately 50%.
(The answers given on direct question checked very closely with calculated results in all except two cases. In one of these two cases, the answer

was 90%, whereas obviously no power was available; and in the other case 16% was given, whereas the calculations showed 41%.)

(11) Average yearly fuel cost—$5,500.

(12) Average yearly machinery space personnel cost per boat—$18,250.
(Includes two boats at less than the average on which no data was received in connection with the machinery.)

(13) The machinery cost could be obtained in only two cases, and these showed an average cost per simultaneously available H.P. of $87.50.

(14) Average calls per month per boat—17.
(Information received on only 8 of the 15 boats)

(15) Average approximate weight of machinery wet plus fuel per simultaneously available H.P.—.138 tons.
(This data apparently is difficult to obtain. Reliable information was received for only three boats.)

The above data show some interesting and definite average conditions relative to the operation and performance of steam fireboats.

First: That the average capacity is approximately 8000 G.P.M. at approximately 165 lbs. pressure.

Second: That the propeller horsepower is about 80% of the pump horsepower.

Third: That the pumps when operating at full capacity, use approximately 85% of the total maximum steam the boilers are capable of delivering.

Fourth: That when the pumps are operating at full capacity, there is only approximately 15% of the maximum capacity of the boilers available for the propellers, or in other words, the propellers could be operated at not more than approximately 25% of their full power.

Fifth: That the average yearly machinery personnel cost and fuel cost together amount to $23,750 for a fireboat of 8000 G.P.M. (For capacities other than 8000 G.P.M., these two items of cost would change but little, since the personnel would not be affected at all and the fuel only slightly because of the influence of the standby losses.)

Sixth: That the limited data obtained shows a machinery cost of $87.50 per simultaneously available horsepower, and a machinery weight of 0.138 tons per horsepower on the same basis.

With the above conditions and data in mind, let us consider the Diesel-electric fireboat and how it fulfills the requirements. The *Port Houston* as shown in the machinery list and the two paragraphs following that list, has an auxiliary engine generator set for supplying the propellers when the main sets are engaged on the pumps. This auxiliary set will supply 140 H.P. to the propellers continuously at normal rating, and in emergency conditions could supply 10% to 20% more. Her normal full power propeller load is 720 H.P., of which the 140 H.P. represents approximately 20% which is very close to the average of the 15 steam fireboats considered, and when taking into account the overload capacity, is practically equal to the average.

Comparisons published recently by advocates of the steam fireboat claim that that type of fireboat will deliver full or nearly full power to the propellers when operating the pumps at full capacity. Certainly the facts

given above do not support this claim. As a matter of fact, the fireboat usually ties up when fighting a fire. In rare cases it stands off in a stream or tide, and then must use a small amount of power on the propellers to hold position. Should it be necessary to tow a blazing vessel and simultaneously fight the fire, there would be plenty of assistance available from regular tugboats which are always on the lookout for business, and thus leave the fireboat free to select the most advantageous position from which to fight the fire.

As a matter of interest, the *Port Houston* could have provided division of power in any desired ratio between pumps and propellers by using slightly larger main engines with either separate generators for propulsion use only, or with slightly larger pump generators and rheostatic control, at the slight additional cost of approximatey $7,000. However, her present machinery arrangement suited conditions better and meets all requirements.

Following the same line of analysis, the steam fireboat advocates base all their cost and weight comparisons on the hypothesis that full or nearly full propeller power is available on the steam boats when operating the pumps at full capacity. Since, however, this hypothesis is not supported by fact, corresponding revision is necessary in their summary conclusions relative to cost per horsepower and weight per horsepower. Likewise, their figures on additional cost of machinery and cost of completed boats are without meaning since they are brought up in a ratio based on the same hypothesis, and here again revision in the conclusion is necessary. Such comparisons and analyses are without value and do not represent the actual situation because the hypotheses are not properly founded. The amount of power needed simultaneously for propulsion and pumping is a variable requirement which is governed by local conditions. Practice indicates that little capacity is needed in excess of the full power pumping conditions. Although some of the steam fireboats have as much as fifty per cent power available for propulsion when pumping full capacity, it is questionable whether there has been occasion to use all of it. Therefore, why provide it unless a special case so requires?

The machinery space personnel cost of the *Port Houston* is $9,240 per year. Comparing this with the average machinery space personnel cost for the steam fireboats, as given above, it will be noted that a Diesel electric fireboat such as the *Port Houston* represents a personnel saving of $9,010 per year. Various individual comparisons of this nature could be made, depending upon the steam fireboats selected. The data on the 15 steam fireboats canvassed show that the machinery space personnel cost varies from roughly $11,000 per year to $28,000 per year. Some of the boats considered are coal burners. However, the average cost of the machinery space personnel for the coal burners is less than that for the oil burners

in the cases considered. This is an item that must receive very careful attention because there seem to have been some very conflicting figures published. Neglecting the New York situation such as obtains on the *John Purroy Mitchel,* which has the highest paid machinery space personnel, one would gather from the information published on steam fireboats that the machinery space personnel cost is in the neighborhood of $10,000 per year. In the case of the Baltimore fireboats, the information which we received indicates that the machinery space personnel cost is approximately 2½ times the figure contained in a recent publication. The situation obtaining at Philadelphia does not, according to our data, exist in any other city. Of ten cities considered, the machinery space personnel cost is close to $20,000 per year, or higher, in five instances.

If the *Port Houston* were operated on as close a margin of personnel as the Philadelphia boats, an appreciable reduction could be made.

Fuel Costs.

The Diesel electric fireboat has practically negligible standby losses for the reason that the main machinery is not operating unless the boat is in service. In the case of the steam fireboat, it is necessary to keep up practically full steam pressure at all times, and this necessitates continuous operation of the boilers. It is true that in the case of the latest developments of oil-fired boilers, this item is reduced to a minimum, which actually represents a fairly low figure. Nevertheless, data collected show that the average yearly fuel cost is $5,500 for a steam fireboat. On a comparable basis, the cost of the fuel for an 8,000 gallon Diesel electric fireboat would be approximately $2,000, thus representing a fuel saving of $3,500 per year.

The total fuel and machinery space personnel cost saving is therefore $12,510 per year.

In comparing costs, it is unfair to consider the entire boat, except only in so far as the different types of machinery affect the cost of the boat. In the case of the *Port Houston,* even the boat cost comparisons are without meaning unless the difference in the design, fittings, equipment, etc., are considered. The reasons for the relatively high cost of the *Port Houston* are given at the beginning of the paper, and need not be reviewed here. In any event, a comparison of machinery costs has no bearing upon the boat cost, except as stated. The limited data available on machinery costs of the steam fireboats show a cost per simultaneously available horsepower of $87.50. On the basis of the *Port Houston,* the cost per simultaneously available horsepower at normal rating is $143, and on the basis of a 10% overload rating is $128. For such short periods during which more than the normal fire-fighting power may be necessary on the propellers, greater overloads are possible with the Diesel electric installation in somewhat the

same manner as they are when forcing boilers, and therefore the costs given for the Diesel electric machinery may be further reduced.

As a matter of fact, we do not regard it as proper to consider the machinery cost on the basis of simultaneously available horsepower in view of the fact that the power required on the propellers, when pumping at full capacity, varies so widely, and also that only a slight amount of power is needed under these conditions. For instance, when reducing the machinery cost of the *John Purroy Mitchel* to a basis representing the same pumping capacity as the *Port Houston,* the cost of the *Port Houston's* machinery would be about 12½% to 15% greater than that of the *John Purroy Mitchel.* The only correct way to make these comparisons is to analyze a specific case of a boat specified for specific conditions. A number of figures have been published showing percentage increase in the cost of Diesel electric fireboats as compared with steam fireboats for the same pumping capacity. These figures in reality are meaningless since the particulars of the machinery considered and layouts of the boats are not given. As a matter of fact, the cost of machinery will not vary in direct ratio to the increase in capacity.

Likewise, certain published figures are in error, since the total simultaneously available horsepower used in the analysis is more than actually exists. For such reasons, very great care must be exercised in analyzing data, and in ascertaining the premises on which the data are based.

The total fuel and personnel saving, when capitalized at 15% carrying charge represents an investment of $83,500, which is the amount that can be paid additional for the Diesel electric equipment before an "even break" is obtained, based on the average conditions. In some instances, this figure will be lower, and in some instances higher.

The machinery weight of the *Port Houston,* including fuel, per simultaneously available horsepower, based on 10% overload is 0.132 tons, which compares very favorably with the steam fireboat machinery. Here again, practically any desired ratio of weights can be obtained, depending upon the type and speed of Diesel engine used. As a matter of interest, the weight per horsepower of the Diesel electric machinery in capacities such as are found on fireboats, has a very great chance of being considerably reduced, whereas that for the steam plant in this application has apparently reached its limit.

Aside from the advantages of fuel and machinery space personnel cost, the Diesel electric fireboat possesses definite advantages resulting from the bridge control feature which enables very accurate and positive handling of the boat in crowded harbors and otherwise restricted waters. Although certain references have been made to bridge control for steam drives, the least we can say is that the appearance of such installations has not been conspicuous.

Oil Tank Fire Tests.

By H. H. Hall.

Standard Oil Company of California (Member N.F.P.A.)

Just three days before the meeting of the American Petroleum Institute, which was held in Los Angeles in January, 1926, a 115 ft. x 35 ft. storage tank containing 17 ft. of engine distillate, burned at the Standard Oil Company's refinery at El Segundo, a few miles out of the city. We did not have very much to say on the subject at the time, because we were somewhat disappointed by the fact that in spite of being equipped with what we considered a first class foam system we were unable to extinguish the fire.

Perhaps I should say right at the start that this foam system was not put in by the Foamite-Childs Corporation, though some of their equipment was used, and our Chief Fire Protection Engineer is an ex-employee of the Company. I might add also that we had foam protection systems in operation before any company specializing in this form of fire protection was organized.

As a large number of pictures are available, both of this fire and of our experiments since, the whole story can probably best be told graphically. (See Picture No. 1.)

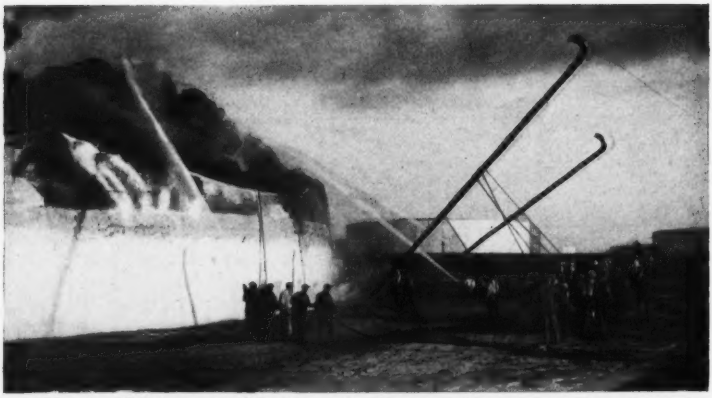
The origin of the fire is not definitely known. The tank was modern in every respect, having a gas tight steel roof, vacuum and pressure valves, and an emergency liquid seal hatch. It was one of the few around the refinery which contained a distillate with vapor pressure likely to produce a combustible mixture within the tank. It was being gauged at the time with a steel tape, and the resulting explosion blew the roof from the tank and caused the death of the gauger. The fire started at 8:52 A. M., and by 8 minutes later, the refinery operators had the foam system in operation.

The tank had been equipped with two foam mixing boxes, of the large size late design. They were supplemented by the addition of special deflectors designed to insure that the foam would be guided against the shell in its downward journey. Immediately after the foam was turned on, it was observed that the box upon which the roof had fallen was discharging most, if not all, of its foam outside of the tank. The foam was therefore turned off from this box and the entire capacity of the system was put through the remaining box. A test immediately after the fire showed that the rate of delivery was about 510 gals. each solution per minute. Picture

Reprinted from the proceedings of the seventh annual meeting of the American Petroleum Institute, at Tulsa, Oklahoma, December 7-9, 1926.

No. 1. The fire in a 115 ft. by 35 ft. oil storage tank containing 17 ft. of distillate at the El Segundo Refinery of the Standard Oil Company of California, a few miles outside Los Angeles. Although enough foam from regular distributors was put on the fire to cover the burning liquid 6 ft. deep, it failed to put out the fire.

No. 1 was taken about 7 minutes after the foam had been turned on. It shows plainly that some progress was being made; but that the progress was extremely slow and unsatisfactory is evidenced by the fact that pumping was continued into this box for 1 hour and 15 minutes, at the end of which time enough foam to cover the tank approximately 6 ft. deep had been used (assuming a net expansion of 6), and the fire was still burning extremely fiercely with no indication of further progress being made. Under the circumstances the management decided that either the mixing box had been damaged or that some other unknown cause was effecting

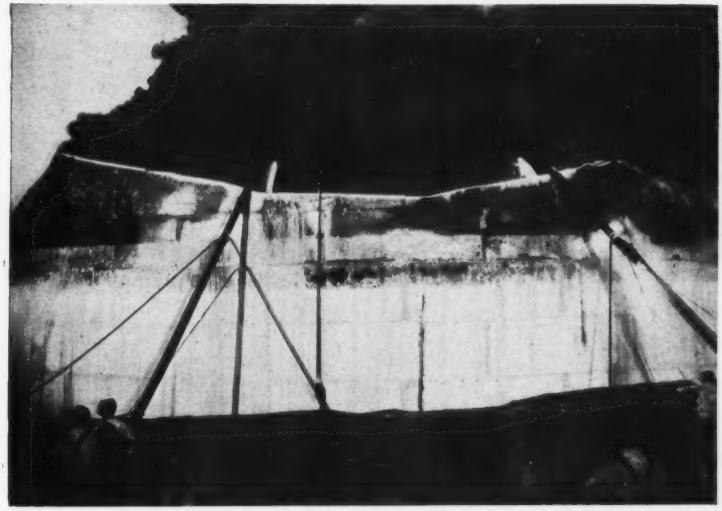


No. 2. Raising portable foam distributors of a type developed by the Standard Oil Company of California. The hose streams are being used merely to cool the tank and protect the men from the radiant heat of the fire.

the efficiency of the foam. They therefore decided to abandon for the time being foam application until such time as they could bring up some of our portable foam mixers and make an entirely new try at extinguishment.

For various reasons this new attempt was delayed for several hours; but eventually portables were brought up, and picture No. 2 shows them being raised. The hoses shown in action in this picture were water streams, used to cool the shell and protect the men from the radiant heat. These portables are a type of equipment developed by our own forces, and the next picture, No. 3, shows that it is perfectly feasible to erect and operate them after a fire has begun. With this new equipment in place foam was again applied at the rate of 730 gals. per min., and pumping was kept up for 31 minutes. Again indications of progress were observed at times, but they were far from pronounced, and did not continue. This time enough foam was pumped on to make a blanket 3½ ft. deep. As the foam stock was being seriously depleted and no further progress appeared to be made, it was decided to abandon further efforts to extinguish the tank and to allow it to burn itself out.

A review of the equipment and methods used in fighting the fire revealed no apparent fault. It was realized that the conditions prevailing at this fire might occur again at any time, and that unless some method of successfully coping with them could be developed, the value of our foam protective systems would be seriously lessened. Our directors accordingly decided to make some large-scale experiments to determine why the fire had not been extinguished. The old shell was moved to a more convenient



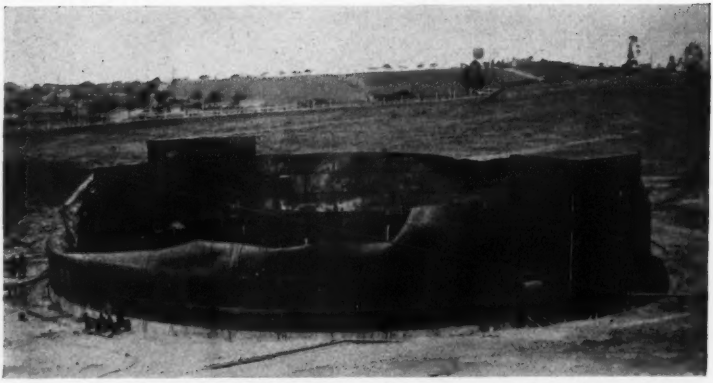
No. 3. The portable distributors in place and operating on the fire. By means of these devices enough foam to make a 3½ ft. blanket on the fire was pumped on, but this likewise failed to extinguish the fire.

location. The bent sheets were straightened up until throughout most of the circumference of the tank it was 20 ft. high and on two opposite sides it was raised to 25 ft. high. (See Picture No. 4.) In addition to that, a great deal of test equipment was put in place. Independent lines were run to each piece of foam applying apparatus, with an orifice meter on each line so that information on the rate of flow was always available. Eighty foot towers were erected to permit observation of the progress of extinguishment inside the tank, and thermocouples were located in about 15 places inside the tank. (A general view of the test layout taken from the air during a test fire is shown in the frontispiece.)

It was attempted in the first test to practically duplicate the conditions of the actual fire. (See Picture No. 5.) The foam mixing box was therefore put in place cocked over just as the photographs showed it in the original fire, and the distance from the box to oil surface was made approximately 20 ft.—just as it had been.

Before putting any oil in the tank, foam was run through this box, and it was observed that the crooked position of the box did not affect the quality of the flow of the foam.

The test fire (see Picture No. 6) was allowed to burn for ten minutes, after which foam was applied at an average rate of 585 gals. per min. for 58 minutes,—and at much higher rates toward the last. At the end of this



No. 4. Because of the failure of foam methods used on the fire shown in the preceding pictures, a series of tests was arranged, remaining parts of the shell of the above tank being reassembled in a convenient location. The tank ready for the tests is shown in this picture. A general view of the test layout is shown in the frontispiece.

time the fire was out, but it had been a terrible struggle, and the method of extinguishment was not considered satisfactory from a practical standpoint. It should be borne in mind that at this test fire we had every advantage of complete preparation and observation, as well as the benefit of the experience of most of the experts of various kinds available in the corporation. These are conditions which cannot be expected to exist at the time of the ordinary fire; and even with these advantages, enough foam was used to put a blanket 5.2 ft. deep over the tank before extinguishment was accomplished—some 33,000 gals. of each solution having been used.

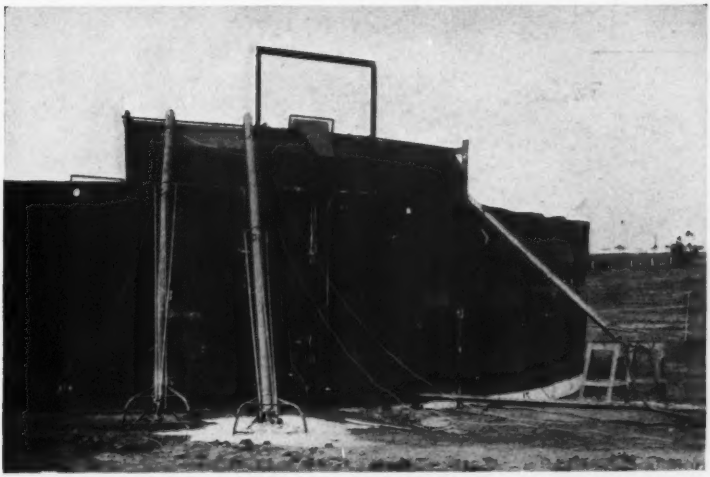
Why Foam Failed.

Observation from both the towers and the ground indicated that foam which is allowed to drop any considerable distance into a fire undergoes the following losses:

(1) A little is dried up as it falls through the heated atmosphere.

(2) A considerably greater quantity is lost due to the up-draft of the fire swirling it out of the tank.

It should be borne in mind that this heat and swirling is the fiercest at the point where the foam is applied, because the falling foam splashes a great deal of oil into the air at that point. When the remaining foam with its high-falling velocity hits the oil surface, it is submerged. This submergence itself no doubt crushes some of the foam bubbles. Part of what remains then comes up into the turbulent and fierce-burning area immediately adjacent to where it went under. Most of this is probably consumed by the fire. Another part is forced some distance out under the oil before



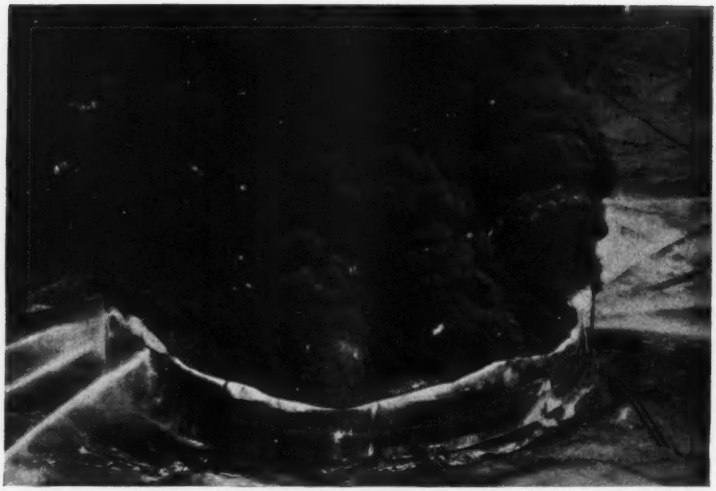
No. 5. As far as possible conditions of the original fire were duplicated in the first tests, the mixing box being tilted over, and the portable distributors used over the sides, dropping the foam some 20 ft. to the surface of the liquid.

it comes to the surface. When it does come up, it is covered with an oil film, which has to burn off before an effective foam blanket is formed. It is easy to see that only a very small part of the original foam applied in this fashion ever does effective work.

In order to see whether this matter of the drop was the only serious difficulty, or whether there were other more important factors handicapping us, it was decided to run a second test in which the foam would be applied close to the oil surface.

A hole was accordingly cut in the tank about 3 ft. above the oil level and the mixing chamber was lowered so as to discharge through that hole. Additional holes were cut at about the same elevation so that our portables could be given the same opportunity to operate with only a few feet of drop. In a later test we demonstrated that these holes can be readily cut after the tank is on fire.

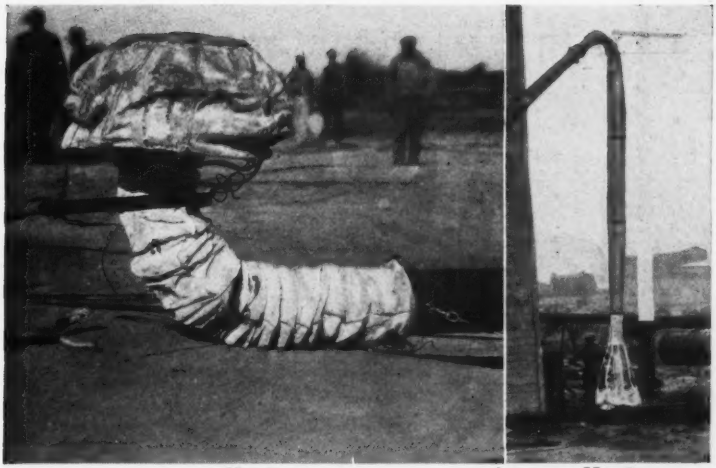
As in the previous test, the fire was allowed to burn ten minutes before any move was made to extinguish it. At the end of that time, two portables were put in place through the side of the tank and about 400 gals. per min. of each solution were applied through them and an additional 400 gals. per min. through the permanent box. As was expected the foam applied in this way proved far more efficient—although even with this small drop the velocity was sufficient to splash the oil at the point of application and make it the hardest burning part of the tank and the last to go out. About 8,400 gals. were used, enough to make a 1.2 ft. blanket.



No. 6. The test fire. With every advantage of operation and observation, such as would not be the case in an actual fire, the fire was not put out until enough foam to blanket the liquid 5.2 ft. deep had been applied. Some 33,000 gals. of each foam solution were used, applied at the average rate of 585 gals. per min. for nearly an hour. It was observed that the dropping of the foam from the height of 20 ft. so damaged the foam that its blanketing power was largely lost.

These two tests had definitely indicated that a long drop from the mixing box to the oil surface severely damages the foam, and may be so serious that it will be impossible to control the fire. We were all convinced that to be in a position where we could confidently expect to extinguish all kinds of tank fires with our foam equipment, we must devise some means of applying the foam in a comparatively gentle fashion and from near the oil surface. We accordingly spent about a month studying various possible schemes for accomplishing such a change in the method of foam application. A great many plans were considered; but the one which appeared to be most feasible was to attach an asbestos tube to our portable mixers, on the bottom of which we proposed to hang something in the general shape of a dishpan either made of metal or asbestos. We figured that such an arrangement would protect the foam during its drop, would kill the velocity at the bottom and then release it at slow velocity and around a big periphery very close to the oil surface. (Picture No. 7 shows tube contracted, No. 8, extended.)

We accordingly built several of these tubes, and some six weeks after our first tests, ran a new series. In this series our first fire was used to check the previous results. A permanent mixing box was set 10 ft. above the oil and tried as a check on the two previous tests. It agreed remarkably



No. 7 No. 8

Asbestos tubes to be attached to the portable foam distributors with something of the general shape of a dishpan at their bottoms, were devised. The tube is to protect the foam during its drop while the pan is to kill its velocity and release the foam slowly around a large periphery close to the oil surface. No. 7 shows the device contracted over the end of a portable, while No. 8 shows it extended.

well, requiring a total of some 11,000 gals. of each solution, or enough to make a blanket 1.7 ft. deep over the tank.

A new fire was then started, and an attempt made to extinguish it with the new type of portables. The airplane view (frontispiece) shows portables on the ground. The observation towers and observation platform can be plainly seen, and off on the right are the two portables with the asbestos tubes rolled up on top of them. After the fire had gotten a good start, the portables were brought up and put in place without serious difficulty by the fire crew. (See Picture No. 9.) The asbestos tubes released just as anticipated, but the results were entirely unsatisfactory, as the tubes broke almost immediately when the full load was put on. Altogether, three portables were erected and every one gave way somewhere. Of course they had been tried ahead of time for strength, but enough allowance had not been made for the weakening effect of the heat and the difficulty of getting both solutions started at once, etc.

After the new portables had failed, the fire was put out with the permanent mixing box set 10 ft. above the surface which had been used in the first of this series of tests.

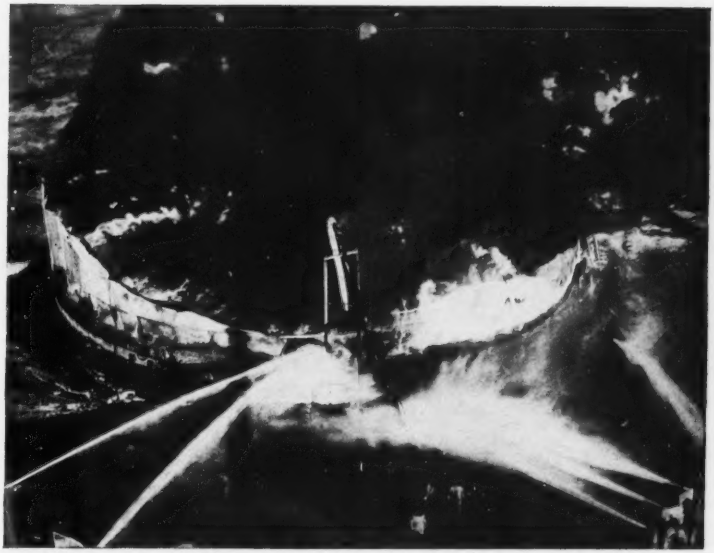
We still had two of the asbestos extension tubes which had not been attached to our portable mixers. As the indications were that, made up as they were, they were of no value anyway, we decided to try them at the

No. 9. Raising the portables with the asbestos tube distributors under protection of shields and hose streams. At the first trial the tubes were damaged by the fire but for later tests they were more strongly reinforced and performed their function.

beginning of the next test. They were accordingly brought up and erected; and while one of them broke at a seam part way down almost immediately, the other stayed intact and worked perfectly. For the first time in any of these tests the fire went out under the mixer almost immediately, and the foam spread from there crowding the fire ahead of it. Some damage was done by allowing foam to flow through the broken mixer which was located close to the effective one, this damage being caused by the splashing of the oil due to the falling foam. The final result was extinguishment in a generally smooth and orderly fashion using a total of 6,000 gals. of each solution—by far the least used in any of these experiments up to that time.

We were now entirely satisfied that the tube extensions would accomplish what we thought they would, that they were perfectly feasible to erect after a fire was started, and that the only defect in our plans was the mechanical strength of the tubes. The original tubes had been built of wire-inserted asbestos cloth with no additional reinforcing of any kind. We accordingly designed some new tubes well reinforced with wire and tried them out.

The results were entirely satisfactory. Two fires just like the previous ones were extinguished with a single portable lowering the foam 20 ft. through the asbestos tubes. The rate of application was only about 200 g. p. m. of each solution and the first fire was put out with a total of about



No. 10. A view from one of the observation towers, the shadow of which can be seen on this and the following pictures, showing the asbestos tube in place over the test fire and beginning to discharge foam.

3,300 gals. of each. In the second fire the tube was damaged a little and 3,700 gals. were used.

In this case (Picture No. 10) the mixer was erected over a frame the top of which was 20 ft. above the oil surface. This spot was chosen rather than the high side of the tank merely because of more favorable wind conditions. Note the position of the shadow of the observation pole. It will show again in the next two pictures.

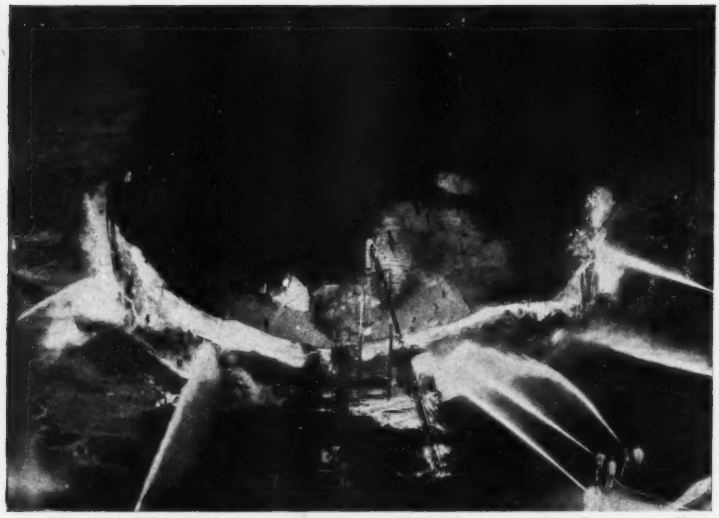
Picture No. 11 shows the extinguishing process going on. Note that the fire is out under the tube, and that the foam has every opportunity to expand and spread without interference.

Picture No. 12 shows fire practically extinguished.

To recapitulate them in round numbers, the relative amounts of foam required to extinguish the same fire by various methods is about as shown in the following table:

QUANTITIES OF FOAM REQUIRED—115 FT. TANK.

Method of Application:	Total Gals. Each Solution
Dropping 20 ft. from permanent box	34,000
Dropping 10 ft. from permanent box	11,000
Dropping 3 ft. from portables without asbestos tube	11,000
Dropping 3 ft. from permanent box and portables	8,000
Dropping 20 ft. from portable with asbestos tube	4,000

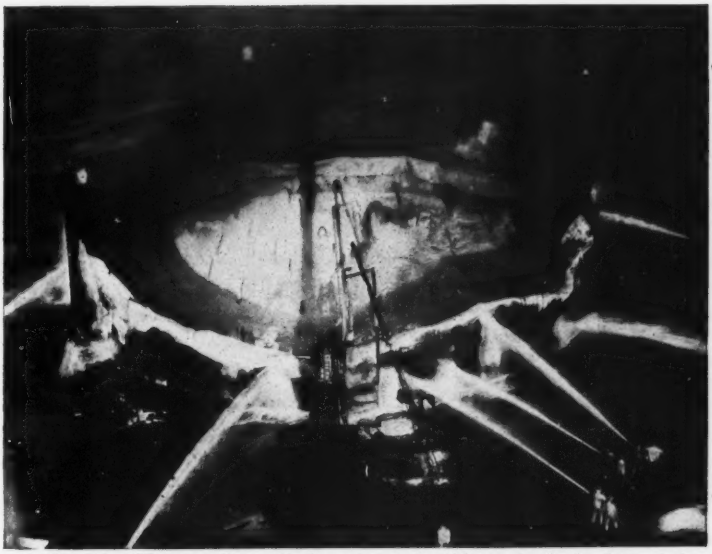


No. 11. The foam successfully applied close to the fire spreading correctly and blanketing it.

We believe this method of foam application marks a distinct advance in the art. You will note the tests show that the basket method of delivery is not only far more efficient when there is a big drop for the foam, but is also considerably more efficient than the permanent box, even with little drop. Immediately this brings up visions of possible future foam systems consisting of mains and hydrants only with possibly smaller solution storage and smaller pumps and a more positive assurance of extinguishing the fire. Bear in mind also that the portables will be stored in a safe place and that they will escape the risk of being damaged by the falling roof, etc.

We assume there will be a considerable demand for this equipment, but have not as yet decided on a definite policy for its manufacture and distribution. Needless to say, patent has been applied for and while it is not the desire of the company to make money out of the invention, we would like, if we can, to get back at least part of what has been spent in experiment. Granting an exclusive license to a manufacturer has been talked of and this or some other plan which will make these mixers and tubes available to the industry will be adopted soon.

This whole thing is a very recent development. It is easy to vision possible change. Bear in mind that in the last test fire we used foam at about half the rate and in about an eighth of the quantity that we had to use in the first fire. In addition to the modifications which those figures



No. 12. The test fire entirely put out by this method, the foam being dropped 20 ft. to the fire, and about 3,300 gals. of foam being used applied at the rate of about 200 gals. per min.

suggest in our permanent installations, it is possible to go even further than that and picture a complete portable outfit. We put out the fire in this 115-ft. tank with 3,300 gals. of solution. We want a factor of safety, but suppose we could be assured of putting the fire out with 6,000 gals. of solution; we have trucks and trailers working on the roads right now that carry 6,000 gals. of gasoline, and they can just as well carry 6,000 gals. of these solutions. That would mean that if we wanted to, perhaps we could have one single fire fighting unit, made up of several trucks or combinations of trucks and trailers carrying with them the necessary portables and solution for extinguishing any tank up to 115-ft. in diameter. It would seem that such an outfit might thoroughly protect an area twenty or thirty miles in diameter. That is just a vision. I don't know whether we will actually do it or not, but these tests make it seem possible.

An Aftermath of War.

A peculiar explosion, fatal to two men, occurred recently at the Interlake Tissue Mills, Limited, Merriton, Ontario. In repairing a beater roll, the two workmen found it necessary to use an electric drill to remove a stud. When the drill penetrated, a violent explosion completely wrecked the beater, blew out a large steel frame window, damaged the building, and scattered debris a distance of one hundred feet. Both men were seriously injured; one died in the ambulance, and the other while undergoing an operation at the hospital. Three others were injured, one of them remaining in the hospital for several weeks before recovery.

Upon examining the scattered remains of the beater roll after the explosion, a fibrous material was found adhering to the spiders. Small samples of this material flamed immediately upon application of a lighted match. A laboratory examination later showed that these fibres were highly-nitrated cellulose, or guncotton, cemented together by iron rust, and containing a small percentage of a gritty substance similar to sand. The existence of this material inside the roll was of course unknown to the management.

The origin of the beater was traced. It was found that it had been purchased from the Munitions Board, and had come from the plant of Nobels, Limited, in the year 1919, when munition factories were being dismantled. The beater had been used in working nitro-cellulose. Apparently some of the material had percolated into the roll between the alternating wood staves and iron bars, which fitted loosely to allow for expansion. Continued wetting later had caused the wood staves to swell and make the roll tight. This highly explosive material had lain dormant inside the roll over six years. A spark from, or more likely the heat generated by, the electric drill had been sufficient to set it going.

Another beater at this plant had come from the same source and had never been opened. How to do this safely was a problem. It was solved by Mr. C. Nelson Gain, Manager, who erected an alum bag rampart and personally bored a hole in one of the wooden staves with an extension bit during the meal hour when the factory was empty of employees. The interior of the roll was then flooded with a ten per cent solution of sodium sulphide, which denitrated the nitro-cellulose and rendered it harmless. Other mills using equipment obtained from munitions factories might well profit by this experience, and take all possible precautions in preventing similar unfortunate accidents.

Reprinted from the January, 1927, issue of the *Factory Mutual Record*, published by the Inspection Department, Associated Factory Mutual Fire Insurance Companies (Member N.F.P.A.).

An Explosion of Illuminating Gasoline.

By Augustus H. Gill.

Professor of Technical Chemical Analysis, Massachusetts Institute of Technology.

Water from a flooded cellar displaced gasoline from the outside tank of an abandoned gasoline-vapor gas machine in a house at Barre, Vermont, on to the water in the cellar. This was ignited from a lantern, resulting in the killing of three persons and the blowing up of a three-story wooden building 57 by 33 feet.

A three-story ell about 18 by 18 feet was attached to the eastern end of the main building above described, which was built about 1902. It was originally lighted by a so-called "gas-machine." This was a 50-light machine of the usual type, consisting of a gasometer-like air pump in the cellar connected to the outside tank or generator by two 2-inch pipes. This was about 49 feet from the cellar and was 6¼ feet in diameter and 2¼ feet high with 4 feet of earth over it: it was divided into 4 compartments and held about 250 gallons of gasoline. The usual pipes were in position on the outside of the tank: the only way of emptying it was by means of these pipes connecting with the bottom of each compartment. Air was forced by the pump through the generator into the gas piping of the house. The gasoline used was 86° Be. gravity, commonly employed. In the course of operation the lighter portion of this evaporated and would leave from 50 to 60 gallons of 70° to 72° Be. gasoline in the generator.

The use of the machine was discontinued in 1906, and some time between 1913 and 1917, the air pump was disconnected and sold in the latter year for junk. The pipes running to the generator were left open and projecting out about 3 feet from the cellar wall and up from the cellar floor. Their connection with the generator made a U tube with arms 2 inches in diameter and 49 feet long, one arm being slightly above the other.

Feb. 12, 1925, the day of the explosion, the cellar became flooded by the backing up of the water in Stevens Brook, the water rising above both pipes leading to the generator. This flooded the generator tank with water, displacing the gasoline therein contained, through either one or both pipes into the cellar and covered the water in the cellar with a layer of gasoline. After the explosion, the air pipe (from near the top of the tank) was cut and actually found to contain water and gasoline of 71.7° Be.: the tank upon being dug up also contaned a little gasoline, sufficient to give a gasoline odor to the water which it contained. Evidence showed that 8 gallons of 71° or 72° gasoline mixed with air would furnish sufficient energy to have produced the explosion.

There being no electric light in the cellar, a tenant and his wife went down into it with a lighted kerosene lantern, as was their custom, and the explosion followed. It threw them both into the water in the cellar and ignited the gasoline on the water there, making a blazing furnace. The man was pulled out through an open window with his clothing burning—a living torch, and his wife was found dead in the cellar. He died eleven or twelve days later. A flying timber killed a young girl some fifty feet away.

The building was wired for electricity and piped for gas in 1905: the service pipe was but 1¼ inch and served only three gas stoves; the use of the gas machine was discontinued in this same year. The gas service entered the basement by a tee and it had frozen up occasionally, requiring the plug in the tee to be unscrewed and alcohol pumped in for thawing out the service. It was claimed that the unscrewing and screwing up of this plug had weakened the fittings so that the tee finally broke and allowed a large quantity of illuminating gas to escape into the cellar. As support for this claim, gas was found burning in the cellar from this service after the explosion (which was a natural sequence of the explosion). It was shown however, that 6000 cubic feet of gas would have been necessary to have caused the explosion and that this must have been supplied within 10 minutes. Since under the conditions, the 1¼ inch service pipe could furnish but 1150 feet of gas per hour, it was clearly impossible for gas to have caused the explosion.

Two other facts supported this view. When the man and his wife started to enter the cellar with the lighted lantern, the instant they entered the landing at the top of the cellar stairs the mixture of illuminating gas and air would have been ignited and the explosion taken place there—as gas is lighter than air and would have risen to this point had it entered the cellar. The second fact was the nature of the burns upon the man: when he was helped out of the open cellar window, his woolen sweater was on fire in different places and he was burned with many third degree burns, that is, those extending into the flesh: the ends of his fingers were perfectly dry and the burns on his scalp went clear to the skull. Medical testimony showed that an explosion of illuminating gas does not burn so deeply as gasoline vapor, and that either would produce only superficial burns. Those received by this man indicated that his clothing and skin had been moistened or even saturated with a liquid that continued to burn after the explosion. A suit for damages was brought against the gas company. The case by agreement was tried before a judge. His findings were:

(1.) That the explosion was one of gasoline vapor which entered the cellar as liquid from the generator, being displaced by the water flowing in from the cellar. This discharged the gas company.

(2.) That the owners of the building knew nothing of the presence

of the generator tank, and were not negligent in not plugging or capping the pipes therefrom to the cellar.

(3.) That the owners did not know or should not have known of an explosive gas in the cellar which would have been ignited by a lighted lantern.

Search among other buildings in the city revealed the presence of another and larger machine with a generator full of gasoline of 72.4° Be.: this had been in the machine, which was in working order, probably about 19 years.

An interesting feature of the case appeared when one of the attorneys in the cross examination of an expert witness asked him for his explanation of the explosion, which has already been given. Then he asked somewhat sarcastically if the witness had "ever heard of an explosion like it," and was much surprised to be answered "Yes," and to the question "Where?", "at East Weymouth, Massachusetts."

The East Weymouth Explosion.

This took place in April, 1918. The facts were something like these. Two ladies were living in a rented house, which years before had been lighted by a small gasoline "gas machine" similar to the one at Barre. The use of this was discontinued, as illuminating gas was put in, and the two ¾-inch pipes which connected with the generator tank were left open, projecting through the cellar wall. These, as in the Barre case, communicated with the underground generator tank.

The overflow from the water tank in the attic had been giving trouble; this was connected with one of the ¾-inch pipes going through the cellar wall—where, the plumber never thought to ascertain—to the generator tank. After this a smell of gas began to be perceived in the cellar and house at odd times, as the water tank overflowed. The gas company was sent for several times, and always found their pipes and meter connections tight, and were never able to account for the "gassy smell."

One of the ladies went down cellar with a lighted lantern, when an explosion took place, killing her and setting the house on fire. She had noticed water in the cellar, as she was wearing rubbers, which was unusual.

Investigation by the State fire marshal disclosed the buried generator tank containing much of the very lightest sort of gasoline: this was shown by the fact that a small glassful of it could be thrown up into the air and none would come down as a liquid. And now comes the most peculiar and, for the gas company, tragic part of the case—suit was brought against the gas company, and it had to pay the damages!—another case of "was the woman hurted and can the gas company pay the bill"?

A Furnace's Odd Collection.

By R. B. Rodgers, Battalion Chief.
Seattle, Washington, Fire Department.

Upon the evening of February 12, 1927, at about 7:40 P. M., the Seattle Fire Department received a telephone call from a much excited lady to the effect that there was much smoke in her home at 1423 Thirtieth Ave., and that she was unable to locate its source. Accordingly an engine company, a truck company and a battalion chief were dispatched to that address. Upon arrival the firemen found the house full of smoke and for a time its source was as much a mystery to them as it had been to the occupants. Being resourceful, however, they finally decided after having examined the chimney, stoves, wiring, attic and all the rooms and closets, that a pipeless furnace with a floor register in the center hall was the trouble maker. Extinguishing all lights, they peered down through the floor register and by means of a flashlight were able to discern a small patch of linty material around the base of the furnace smouldering. To get at the burning material it was necessary to remove the outer sheet metal casing of the furnace after which the small fire was easily extinguished.

Observing a quantity of lint and sweepings about the furnace base the firemen decided to clean this out and thus avoid a repetition of the smoke episode. The furnace yielded an odd collection of 90 separate articles along with a large bushel basket of sweepings and lint all of which had been dropped through the floor register at various times. The list follows:

1 cameo ring	7 pencils	1 sea shell
1 stick pin	5 curtain rods	1 common pin
1 cameo pin	3 handkerchiefs	1 sewing needle
1 pearl bead	5 buttons	1 tin whistle
1 bronze medal	7 hair pins	1 cloth belt
1 car token	3 cigarette butts	2 wood screws
2 keys	3 lollypop sticks	1 safety razor blade
1 mechanical toy	2 tooth pick	1 piece cloth
1 toy scuttle	2 spools thread	1 corset steel
12 safety pins	2 clothes pins	1 comb
13 matches	2 marbles	1 rubber heel
1 blacking dauber	1 chicken bone	1 bushel sweepings

The lady of the house when apprised of the situation said: "What! My furnace dirty? Why I just paid six dollars to have it cleaned!" Floor registers are a constant source of danger from fire through such carelessness, though in this instance the loss was small. A little fire prevention education of the householder and the chimney sweep would in this instance have prevented considerable annoyance, some ill feeling, would have eliminated a potential fire loss and kept one alarm of fire out of the appalling annual record.

Bangor, Maine, Conflagration.

Report by Underwriters' Bureau of New England.

(Member N. F. P. A.)

A conflagration typical of the kind that can occur in the high value districts of many cities, where the buildings are of inferior construction and where they are entirely unprotected against the spread of fire, occurred in Bangor, Maine, on the night of February 13, 1927. The loss is variously estimated to be between three quarters of a million and a million dollars.

The destroyed buildings included several of miscellaneous mercantile and office occupancy and the Y. W. C. A. building, comprising about half the block bounded by Columbia, Cross, Main and Hammond Streets, and in which the City Hall is located.

The accompanying diagram shows the general layout of the destroyed area. The fire originated in the middle of the group of buildings, these being mostly four story brick-joisted, with much wooden trim in the interior. Although there were numerous party walls there were no fire

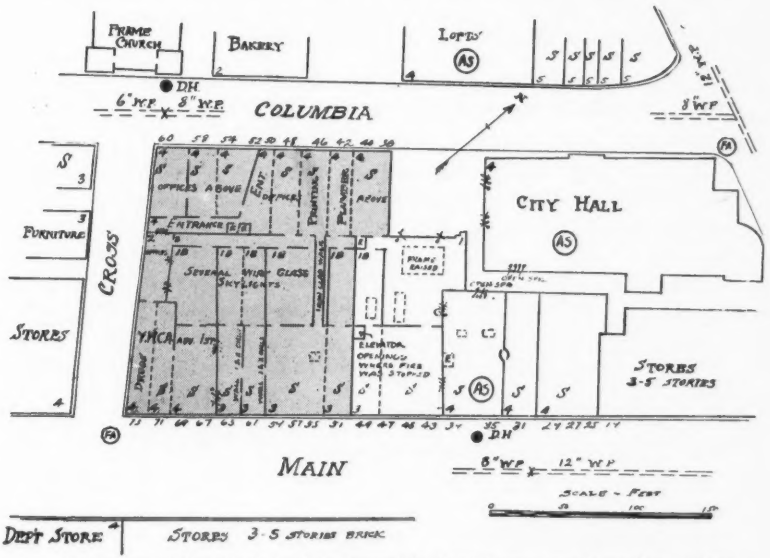


Diagram of the block half destroyed in the Bangor conflagration. Note that the burned area was entirely built upon, and that all areas were mutually interconnecting. The shaded section shows the extent of the fire.

P. & A. Photo.

The Bangor, Maine, fire department found a large part of one block ablaze when they arrived to fight this fire. This is the appearance of the building in which the fire started shortly after the firemen started work.

walls, and a long wood-sheathed passageway in the basement connected practically all the areas involved in the fire. There was apparently little or no protection of floor openings.

The fire was discovered by a passerby who pulled the fire alarm box at the corner of Main and Cross Streets. Although there was no delay in the arrival of the fire department, the fire had spread to nearly all the buildings in the south end of the block by the time the fire department arrived so that its efforts were necessarily devoted to preventing the fire's further spread. The department apparently did good work in checking the fire by making a stand behind a partial fire wall at the side and rear of No. 49 Main Street. This partial fire wall had unprotected openings at an elevator shaft in the rear through which hose streams could be directed into the destroyed buildings. Hose streams directed from the areaway in the rear of the City Hall and from Main Street prevented the fire from entering the building at 49 Main Street through the windows and from igniting its cornice.

A sprinklered brick bakery across Columbia Street was damaged when the fire scorched the window trim at the front, but standpipe hose streams

Underwood and Underwood.

A general view of the ruins of the Bangor conflagration looking from the corner on Main and Cross Streets. Large areas, unprotected floor openings and unprotected openings in fire walls enabled the fire to spread rapidly through all the areas shown, making tremendous headway before discovery.

kept the fire out of the building. The frame church next door to this was protected by hose streams. The fire was kept out of City Hall with little difficulty, the exposure not being severe. The City Hall was sprinklered with outside sprinklers for window protection. As a precaution the open sprinklers were operated, also some on the rear of the building at 35-39 Main Street. Some damage was done (mainly broken glass and scorched paint) to the buildings nearby and across the streets from the fire.

This was the second bad fire Bangor has experienced, the entire business district having been destroyed by a conflagration of May 1, 1911, which did $10,000,000 damage and cost the lives of 3 men.

Bedding Factory Fire in St. Paul.

By John Townsend, Jr., Superintendent.

St. Paul Fire Insurance Patrol (Member N.F.P.A.)

A fire which started in a cotton carding machine of the United States Bedding Company's plant on the night of January 17, caused a total loss to the entire plant and a total loss to the Northwood Sounding Board Company, which occupied the west portion of the building, and communicated to a row of frame dwellings across the street. Flying brands ignited twenty-one wooden shingle roofs, some of which were five or six blocks away from the fire. The fire caused a loss of nearly $600,000, the greatest single fire loss on record in St. Paul.

Two men were working at the carding machine which was located in a room on the second floor of the east building. This particular machine had been in operation throughout the day and no trouble had been experienced with it up to this time. Suddenly, as the "camel back" operated, flames burst out on the under side of it. One of the operators obtained a hand fire extinguisher and attempted to put out the fire. In the meantime the other employee sent in the alarm by pulling one of the A. D. T. boxes which were located throughout the building.

The flames spread so rapidly from the carding machine to baled cotton in the room, that the man fighting the fire was not able to escape from the building before he was badly burned about the head, face, and hands, and he has been confined to a hospital for the last two months on account of these injuries and will probably be partially disabled the rest of his life.

From past experience with these carding machines it is thought that a piece of metal, possibly a loose bolt or a small piece of baling strap, struck a spark when it came in contact with the knives of the machine. This spark in turn ignited the cotton which on account of being pressed between rollers merely smoldered until it reached the "camel back." At that place the cotton was thrust into the air in its course through the machine and immediately burst into flame. The same action takes place when a cotton mattress is set on fire. It will smolder until the mattress is broken open after which the cotton burns very rapidly.

As shown by the accompanying photographs the building was practically destroyed as was the machinery and probably all of the stock. There may be a small amount of salvage in the basement but this cannot be determined until the walls are torn down and the debris cleared away. The buildings on the north were not damaged to a great extent, but dwellings across the street on the south were badly scorched. This fire proved

A large bedding factory in St. Paul, Minn., furnished this spectacular fire on January 17, 1927, causing the greatest fire loss ever recorded in that city. So rapidly did the fire spread that the entire building was ablaze when the fire department arrived.

a very good object lesson of the flying brand hazard of the wooden shingle. There were twenty-one wooden shingle roofs ignited by flying brands, some of the roofs being five or six blocks distant. Fortunately, all of the dwellings in the block directly south of the fire had composition roofs and while four of these roofs were damaged by the radiation of heat and large burning brands lodging on them and melting the pitch in the roof, none of them were actually ignited, and it was only due to the fact that there was a small amount of snow on all the roofs and that the velocity of the wind was about 12 to 15 miles per hour that this fire did not reach the proportion of a serious conflagration.

This large loss was due entirely to the fact that the sprinkler system was shut off completely throughout the building. There had been three fires in the bracker picker machines in the past four years and each one of these fires has been controlled by the sprinkler system operating. Of course, in a manufacturing plant of this kind the stock is very flammable and the resulting spread of fire from this carding machine was more in the nature of a dust explosion than the ordinary spread of fire in less flammable stock. The dust from these machines fills the air and forms a coating over everything in the plant.

The main portion of the plant was a two story brick building of heavy beam and ordinary joist construction with part basement under the east portion. It was erected in 1906 and 1924 and kept in good repair. The

walls were 16 in. brick, and brick interior walls divided the building into three sections with pine and glass partitions on each floor. The roof was flat, of composition laid on 1 in. and 2 in. boards and joists. Skylights with thin glass and wooden frames and wired glass and metal frames were used. The first floor was of concrete, those above were of wood 3 in. thick laid on 6 in. x 12 in. beams. The ceilings were partly open beams, part metal and part open joists. There were three open stairways and an elevator shaft and one open chute. There were single non-standard fire doors separating the east and west building. These failed to confine the fire to the place of origin. The windows were ordinary glass set in metal frames. There were no fire shutters or open sprinklers. The management was good, and the buildings with the exception of the warehouse were well kept up. Refuse, sweepings, oily rags and waste were fairly well cared for.

There were 6 A. D. T. watchmen's boxes placed throughout the plant and the alarm was sent in by one of these boxes at 5:47 P. M. The District Chief, 2 engine companies, one truck company, one squad company, and the insurance patrol responded to this alarm. The chief upon arrival found the entire east portion of the building in flames and he immediately sent in a 4-11 alarm. The time of this alarm was 5:54 P. M. This called out 3 more engine companies, 2 truck companies, and another squad company. The chief and assistant chief also responded to this alarm. At 6:11 P. M. a special call was sent in for 3 more engine companies, and at 6:49 P. M. another special call was sent in for 3 more engine companies. The crew of firemen that went off duty at 6:00 P. M. were called back to the service at this time. Altogether there were 11 engine companies, 3 truck companies, 2 squads and both crews of the insurance patrol at work at 7:00 P. M. Sixteen lines, or 11,650 feet of hose were used, and 216 men were at work at this fire.

Lines of hose were laid and water was played on the fire, but as mentioned before the whole building was a mass of flames and the water had practically no effect. The heat was so great that engine companies could not get close enough to connect lines to the fire department connection on the building. The last 3 engine companies to arrive were placed so that they might protect the dwellings on the south side. These houses were badly scorched, the paint blistered and windows cracked by the heat. It was extremely difficult for the firemen to stand on the south side of the fire and protect these houses on account of the heat and it was only by cooling themselves off occasionally with water from the hose that they were able to stand it at all. Even at that several had their hands and faces scorched. All of their rubber coats showed the effect of the heat afterwards. On the west end of the building, which was occupied by the Northwood Sounding Board Company and where the fire was burning more

Large fire areas and a shut off sprinkler system allowed the fire in this St. Paul bedding factory to flash through the plant, part of which was occupied by a woodworker, causing a total loss of nearly $600,000. Twenty-one wooden shingle roofs were also ignited by flying brands, some of the roofs being five or six blocks distant.

fiercely than the rest, lines of hose were siamesed into a turret nozzle on a combination pumper and two more lines were siamesed into a deluge set.

The post indicator valves were found shut off at the time of the fire and the sprinkler risers in the basement were also found shut off. When they were questioned about it, officers of the United States Bedding Company could give no reason for the sprinkler system being completely shut off. No one seems to know why or when these sprinklers were turned off The engineer had tested them at 4:30 P. M. that day and found them in good working order at that time. As stated before this fire would have never gained the headway it did if the sprinkler system had operated.

At the time of the fire the wind was blowing from the north at a velocity of about 15 miles per hour and seriously threatened the dwellings on the south, but about an hour later it shifted to the west and it was probably due to this fact that these houses were saved from complete destruction. The temperature was 10 below zero, which, of course, hampered the firemen a great deal by causing the lines of hose to freeze wherever they came in contact with the ground, covering the ladders with ice and coating the firemen's clothing with ice which made it extremely difficult for them to move quickly. There was no loss of life due to the fact that most of the employees were dismissed from work at 4:30 P. M. and only a few were working in the building when the fire occurred. The only injuries suffered were by the employee who was badly burned endeavoring

to extinguish the fire in the carding machine. A few firemen had their faces scorched, and most of them suffered more or less from frost bitten hands and feet.

As the building and contents were a total loss nothing could be done by the bedding company or the salvage patrol to protect it from further loss. Three engine companies remained at the fire for about 24 hours afterwards pouring water on the smoldering ruins, and during the week an engine company was sent up every day to extinguish some small fire that would break out in the cotton bales stored in the basement. It was impossible to pull these bales out in the open as the brick walls were in danger of falling at any moment, they being held together by ice rather than anything else. All piping of the sprinkler system inside the building was of course completely destroyed.

There are many lessons in fire prevention to be learned from this fire. The first and most important of which is that a sprinkler supervisory system should have been installed in this building. The next important lesson is that the building should have been divided into *good* fire divisions with *standard* fire doors. The fire also demonstrated the need of enclosing all stairways and floor openings in an approved manner and extending sprinkler system to cover all parts of building. The rapidity with which the fire spread throughout the building, which is about 600 feet long, demonstrates how important the fact is, that a manufacturing plant of this kind filled with such flammable materials as cotton and excelsior must be divided into small and properly protected fire divisions.

A Cold Storage Plant Fire.

By J. N. Elwood, Inspector.

New York Fire Insurance Rating Organization (Member N.F.P.A.)

A fire which started on January 24, 1927, smouldered in the inaccessible walls of a cold storage plant and baffled the firemen of Rochester, N. Y., who worked under great difficulty, due to cold weather and snow, for 89 hours before it was finally controlled.

The building was formerly a brewery, having been converted into a cold storage plant about 25 years ago. The building, some 50 years old, was of heavy brick and timber construction. Insulation consisted of 4 in. of cork lining cemented to the outside brick walls, the cork being covered with 7/8 in. wood sheathing. Two by four studs were next erected and these in turn sheathed so that a 4 in. air space was provided in addition to the cork insulation.

The fire started near one of the refrigerating machines in the basement of the south end of the plant. Refrigeration was accomplished by the fan

Some idea of the difficulties under which the Rochester, N. Y., firemen worked in fighting a fire in a large cold storage plant on January 24 is given by this picture. The fire, smouldering in the wall insulation, was not brought under control for 89 hours.

and duct method, cold air being blown from the basement through a brine room into wooden ducts leading to the various storage rooms. Apparently the fire followed this draft and from these ducts burned into the wall sheathing and cork insulation, thus spreading through the walls, in which it was totally inaccessible.

In the early stages of the fire twenty firemen were overcome by smoke which could not be readily ventilated from the building. The fire was not brought under control until many holes had been drilled in the walls from the outside, thus providing ventilation and making it possible to apply water to the burning insulation.

A Marine Dust Explosion.

By Walter C. Neely.

(Member N.F.P.A.)

The explosion of asphaltum or pitch dust during the loading of the French barque *Richelieu* at the pier of the Baltimore and Ohio Railroad at Baltimore on January 4, 1927, was noteworthy as the first recorded case of a dust explosion aboard ship. As a result of the explosion and fire, five men were killed and the ship took fire and later sank.

The ship was loading the pitch or asphaltum in bulk. The pitch was brought alongside the ship's loading berth in cars, then dumped into loading bins and thence by means of conveyors delivered to the chutes through which it was distributed to the various holds of the vessel, the chute extending down into the hold. At the base of this chute is a device known as a "mechanical trimmer" consisting of a short belt, operated by electricity at high speed, which serves to throw the pitch out and distribute it about the hold. The pitch looks something like large lumps of anthracite coal and in being thrown about the holds in this manner creates a great deal of dust.

This account should prove of interest to railroads owning or operating pier terminals, and indicate an exposure hazard to such terminals from vessels alongside, particularly while loading cargoes of coal, asphaltum, grain, and other materials which give off a dust during the loading period that may be explosive or flammable.

This particular shipment of asphaltum represented the residuum obtained from the manufacture of water gas (basic coal tar), which gives off a dust more freely than coal, being explosive in the proportion of one pound to 500 cu. ft. of air. The fire started about 5:08 P. M., a series of explosions or flashes occurring, followed by rapidly spreading fire in the cargo, causing death and injury to a number of colored laborers who were in the ship's hold "trimming" pockets of the cargo with shovels and supplementing the loading and "trimming" performed by electrically-operated machinery. The alarm was transmitted promptly from the fire alarm box on the pier and the fire was fought until midnight by city fire department and fireboats, the ship sinking in about 36 ft. of water, lying against the pier at an angle of approximately 45 degrees.

The origin of fire is not known, but the following possibilities have been offered. The dust ignited from open fires on board ship; from fire in the cargo itself; from an open flame of a torch, match or smoking material; from a spark from friction in loading the cargo; or from a spark

P. & A. Photo.

Fighting the fire in the French barque "Richelieu," the result of an explosion of pitch dust during the loading of the ship at the Baltimore & Ohio railway terminal at Baltimore on January 4. The explosion killed five men.

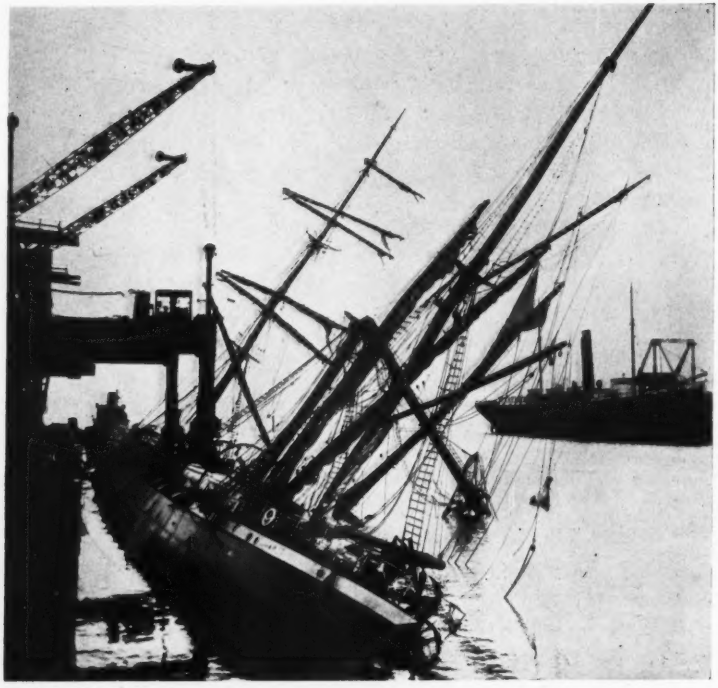
or hot metal from electric resistances or other electrical appliances on the conveyor or trimmer arms.

The pier at which the vessel was tied is entirely of fire-resistive construction, 700 ft. long by 115 ft. wide, being of reinforced concrete and equipped with steel car dumpers and concrete storage bins on shore, and with steel loading towers on the pier receiving coal from large rapidly moving belts and conveying it into the ships by the steel conveying and "trimming" apparatus, all electrically-operated. This handling machinery is designed to prevent the breakage of coal while loading it and at the same time to increase the speed at which the loading may be accomplished.

It is stated the loss to the ship is $800,000, while the damage to the railroad pier is estimated at $40,000, consisting principally of damage to or destruction of electric motors and other electrical apparatus, belting, pulleys, etc., and damage to steel conveyors and trimmer arms, which, in the excitement of the fire and the need for rescuing the men, were not withdrawn from the ship when the fire started. There is also some damage to concrete piling, caused by the ship sinking alongside the pier.

Failure to remove the ship from the pier in the early stages of the fire is due to time spent and efforts made in rescue of the men and their removal from the ship to the pier.

Care should be taken to prevent similar accidents in the future by taking the following precautions which this fire demonstates to be necessary for the safety of employees and others from loss of life or injury.



P. & A. Photo.

The "Richelieu" as it sank at its pier following the dust explosion and fire. This view shows two of the conveyor chutes which were delivering the asphaltum or pitch to the holds when the explosion occurred.

These will also help to avoid the operating inconvenience of a vessel scuttled or sunk in dock.

Open flame torches, oil lamps or any other open forms of fire, should be prohibited in the holds or other hazardous locations of ships loading or unloading at railroad terminal piers. Safety electric hand lanterns should be used. Every effort should be made to prohibit smoking or the striking of matches for any purpose in the cargo spaces or other hazardous locations on ships at railroad terminals.

The electric motors on trimmer arms, which must necessarily be lowered into the holds of ships in the immediate vicinity of flammable cargoes, should be of the enclosed dust-proof type. The resistances or other open electrical appliances should be of a portable type, and so arranged as to be located on the pier or on the deck of the ship. Furthermore, if necessary to enforce these regulations, special officers or watchmen should be designated to remain on shipboard during loading or unloading.

Loss of Life in Dwellings—Fire Record.

This record has been compiled from the reports of 309 fires in which a total of 648 lives were lost. These reports in the files of the N.F.P.A. Department of Fire Record represent a small fraction of the total loss of life by fire in dwellings, but it is considered that the number is large enough to be of value in drawing conclusions as to the manner in which the lives are lost. This tabulation supplements the loss of life fire record published in the January, 1925, QUARTERLY (Vol. 18, No. 3, page 296) in which was given a record of 3,207 fatalities in buildings of all occupancies other than dwellings. The general plan of treatment of the present tables is similar to that of the previous record.

These tables summarize the causes for the loss of life, as distinguished from the causes of fire. A fatality due to a fire originating in rubbish in a basement would, depending upon the circumstances, be classified as "suffocation while asleep" or "inadequate exits," rather than as due to rubbish. Where direct fire causes are cited as causes of fatality in the tables, this means that the loss of life was due to burns or the ignition of clothing by the originating cause of the fire.

This record takes no cognizance of damage to buildings. In most of the fires included the buildings were destroyed, but in a number of the fatalities recorded fire did not communicate to the contents or structure of the building. These tables are thus prepared on an entirely different basis from the usual fire record statistics and should be read with this viewpoint in mind.

The average loss of life per fire is two persons. Of the deaths where the age and sex of the victims is reported it is shown that 15% are men, 26% women and 59% children.

This table does not include injuries except as a reference to 118 injuries which occurred in the same fires in which the losses of life occur. No record has been made herein of any fires where persons were injured but where there were no fatalities.

The tables are for the most part self-explanatory. Under "Burns and Ignition of Clothing" the three causes, burns from using kerosene or gasoline in stoves, gas explosion and matches, contribute more than half of the total of 202 deaths recorded under this heading. In this classification are included deaths from fireworks and from bonfires. While the bonfires were obviously not inside buildings and the fatalities due to the use of fireworks mostly occurred outdoors, the majority of these occurred in

yards of dwellings and it is felt that they should properly be included in this tabulation.

The tables show that a greater number of fatalities come under the general heading of Construction than under any other of the main classifications. In most cases there is no positive evidence that the fatality was directly attributable to faulty construction, but in all those classified it has seemed clear that with a better character of construction the loss of life would have been avoided. A large number of fires start at the bottom of an open stairway or in a basement, spreading up the stairway and through the halls. In such cases it is frequently difficult to determine the exact reason for the loss of life, this, however, being obviously due to suffocation or to lack of exits, or both. Suffocation of sleeping persons is classified under the general heading "Construction" on the ground that with proper construction and arrangement of buildings this sort of fatality would not occur. Here it is often impossible to tell whether the victim was actually suffocated while asleep or whether he awoke too late to avail himself of exit facilities.

The sections of the table captioned "Fire Fighting and Salvage" and "Miscellaneous" require no special comments, except that the cause "Children Alone" deserves special attention. These fires occurred with one or two exceptions in the daytime, small children being left alone in the house while their parents were away. The age of these victims is in most cases less than five, although a few older children lost their lives in this way. In the majority of cases the children were locked in a house and could not escape from the fires that they started by playing with matches.

There are in the records a considerable number of fatal fires which occurred at night and where the fire was so far advanced before discovery that it was impossible to determine the exact manner of the loss of life. In such cases the immediate cause of the fire or the place where it started is frequently determined, but when all the occupants of a building lose their lives there is no evidence remaining after the fire to show whether the people were suffocated while asleep or whether they were awakened by the fire, but could not escape because of inadequate exit facilities.

Loss of Life by Fire in Dwellings.

Total number of fires in which lives were lost	309	
		%
Number of men killed	94	15
Number of women killed	159	26
Number of children killed	368	59
Total number known	621	
Total number no data as to sex and age	27	
Total number of lives lost	648	

There were 118 injured in these fires.

Causes of Loss of Life.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Burns and Ignition of Clothing.

Classified in accordance with the direct cause of death, including cases where the victim died of burns, irrespective of whether or not the building was ignited. Cases where loss of life is due to failure to escape from a burning building, whatever the primary cause of fire, are classified under construction.

Burns from using kerosene or gasoline in stoves	52
Gas explosion	26
Matches	22
Sparks from stoves	11
Gas stoves	10
Oil stoves	10
Furnaces	10
Fireworks	9
Bonfires	9
Kerosene lamp or lantern	8
Gasoline explosion	6
Gasoline or kerosene for cleaning	3
Candle	3
Acetylene gas tank explosion	3
Stove polish igniting	3
Grain alcohol fumes igniting	3
Gasoline blow torch	2
Motion picture film "exploding"	2
Smoking in bed	2
Rectifier used in charging radio battery	1
Celluloid toy catching fire	1
Lighting gas jet	1
Flame from gas iron	1
Gasoline ignited by lantern	1
Clothing saturated with gasoline igniting	1
Can of varnish fell on stove and ignited	1
Amyl-acetate explosion	1
Total	202

Construction.

Fatalities which would have been prevented by superior construction.

Fire started at bottom of stairway or in basement and extended up open stairway. No other exits. Loss of life due to suffocation or lack of exits or both	192
Suffocation, while asleep	32
Suffocation, while awake	26
Invalid's or aged person's escape cut off	8
Jumping from burning building	1
Total	259

Fire Fighting and Salvage.

Fatalities resulting from remaining in buildings to fight fires which were beyond control, or from entering burning buildings in ill advised attempts to save valuables.

Entering burning building	25
Burned while trying to extinguish fire	4
Total	29

Miscellaneous.

Children left alone	69
Panic unexplained	4
Still exploding	3
Shock	3
Total	79

Insufficient Data.

In these fires while the cause of the fire and attendant circumstances are reported in detail, there is insufficient data to determine the exact manner of the fatalities.

Night fires, fatalities in most cases presumably due to suffocation while asleep, or to inadequate exits	61
Day fires, fatalities in most cases presumably due to burns or ignition of clothing	18
Total	79

SUMMARY.

Burns and ignition of clothing	202
Construction	259
Fire fighting and salvage	29
Miscellaneous	79
Insufficient data as to cause of fatalities	79
Total	648

Fires in Which There Was Loss of Life.

These notes are intended to point out typical conditions under which loss of life has occurred that they may be known and guarded against.

Children Left Alone.

L-83. QUEBEC, P. Q., JANUARY 11, 1927. Three children, all under two years of age, were left alone in a house while their parents attended to work on a farm. A fire, which started from an unknown cause, destroyed their home. There was no chance to rescue the children and their charred bodies were found in the debris after the building had been consumed.

L-84. TORONTO, ONT., JANUARY 16, 1927. Four children, the eldest only four years old, were burned to death when a fire, believed to have been caused by an overheated stove, destroyed their home. The fire started while the parents were visiting neighbors.

Starting Fires with Kerosene.

L-90. LIMA, OHIO, FEBRUARY 7, 1927. A mother and three of her children were burned to death when fire destroyed their home. It is thought that the mother attempted to start a fire with kerosene when the can exploded. A nine-year-old girl grabbed the baby from its crib and attempted to escape by the front door, but found it locked. She finally got out through a rear door and carried the baby nearly a quarter of a mile through the cold to summon aid. When help arrived it was too late to save the mother and the other children.

L-95. ALGONA, IOWA, FEBRUARY 26, 1927. Two children, five and six years of age, were burned to death when they were trapped by fire in a bedroom where they were sleeping. The father was trying to hurry a fire in the kitchen range with kerosene in a can which had held gasoline. The mixture exploded and the blazing liquid was thrown all over the kitchen. The bedroom was just off the kitchen and part of the kerosene ignited the connecting doorway, which made it impossible to reach the children, although the father and an older son were badly burned while trying to do so.

L-103. BROWN'S MILLS, N. J., MARCH 11, 1927. The result of pouring kerosene on the smouldering embers of a fire in a kitchen stove, was an explosion and fire which caused the death of a father, his four children and a grandchild. The mother and another daughter were badly burned in trying to rescue the children. A son jumped from a second story window and was the only member of the family to escape injury.

Overheated Stove.

L-104. TUNNELTON, PA., MARCH 12, 1927. An overheated stove is believed to have caused the fire which resulted in the death of a family of seven, and another mother and one child. The fire had gained such headway when discovered that it was impossible to rescue any of the persons in the house. The bodies of the children were found in bed, as if they had been overcome by smoke and had died without awakening. The only person to escape from the house leaped from a second story window. He was probably fatally burned while making an effort to rescue his wife and child.

Gas Stove.

L-99. NEWARK, N. J., MARCH 3, 1927. A twenty-three-year-old mother died from burns sustained when her dress was ignited by a gas stove in the bedroom of her home. As she bent over a bed to get her baby, her dress brushed against the open flame of the stove and caught fire. She rushed out on the rear porch of her home where her cries were heard by a neighbor, who extinguished the flames, sustaining severe burns himself in doing so.

Gasoline-Matches.

H-24206. DEDHAM, MASS., FEBRUARY 1, 1927. One man died from burns he received when, with two other men, he was investigating a leak in the tank of a motor truck and the tank blew up. The men lighted a match to trace the leak in the gas line while the truck was standing at the side of the road. The other two men were also badly burned.

Dry Cleaning with Gasoline.

H-24214. RED BANK, N. J., DECEMBER 12, 1926. A Japanese butler was burned to death in a fire which destroyed a private garage. The butler went to the garage where there was a lighted stove, to clean some clothes with gasoline. After the fire had been extinguished the body was found lying beside an empty fire extinguisher.

Flammable Flooring Compound.

H-24190. BOSTON, MASS., JANUARY 15, 1927. An employee was laying a flammable floor preparation, in a building which was under construction, when a spark from a broken electric light bulb ignited the composition. An explosion followed and the employee was burned so badly that he died. Three other workers were knocked down by the force of the explosion.

Oil Burner.

S-44076. WATERTOWN, MASS., FEBRUARY 18, 1927. DRY CLEANING PLANT. A "flare-back" at an oil burner, caused apparently by the damper not being open when the fireman attempted to start up an additional boiler, resulted in the fireman losing his life. His clothing was sprayed with burning oil and he died a few days afterwards from his burns.

Dust Explosion.

S-43996. CEDAR RAPIDS, IOWA, JANUARY 25, 1927. CEREAL MILL. A grain dust explosion, the exact cause of which is not known, resulted in the death of a workman who just prior to the explosion had entered a room on the sixth floor of the mill for the purpose of cleaning it. Two men working on the second floor were badly burned but were rescued.

Gasoline Vapor Explosion.

H-24070. WILMINGTON, CALIF., DECEMBER 28, 1926. TRANSIT SHED AND DOCK. A gang of ten men were engaged in working on a new pipe line under the dock. A connection was to be made to a gasoline line crossing the channel and this line was supposed to have been drained of gasoline, washed out with water and blown out with air before opening. Before the gasoline line was opened all welding was stopped. When the line was opened some water drained out undoubtedly accompanied by some gasoline. This gasoline evidently formed a vapor under the dock where the men were working. The men had been working several hours under the dock and apparently they did not notice the smell of the gasoline vapor and after placing a blank flange on the gasoline line the welder was called back to complete his work on the new line. Soon after his torch was started a flash occurred followed by a severe fire under and near the wharf. All of the men jumped into the water, swam the channel and were later rescued with the exception of one who had not been accounted for. Of those who swam the channel seven received serious burns, which resulted fatally in one case.

Attempted Salvage.

H-24024. GREENWICH, CONN., DECEMBER 23, 1926. GIRLS' BOARDING SCHOOL. A fire, which is thought to have started from a spark lighting on the wood shingle roof at the time the fires were banked, caused the death of one man. Some of the employees of nearby estates were trying to save some of the furnishings and valuable works of art and one of them was trapped in a lower floor and was burned to death.

Fighting Fire.

H-24023. WINNIPEG, MAN., DECEMBER 23, 1926. Four firemen were killed and eleven were seriously injured in a fire which destroyed a theatre. The firemen were inside of the building when they heard the beams cracking and started to retreat. The wall crashed without warning and buried a number of the firemen. The ones who were injured were removed to a place of safety, but those who were killed were permitted to remain beneath the pile of debris until it was safe to work close to the building.

Annual Sprinkler Tables.

Statistics of Fires in Properties Having Automatic Sprinkler Protection.

NOTE.—These tabulations are made at the close of each year with the object of furnishing a basis upon which the virtues of the automatic sprinkler as an extinguishing agent can be estimated.

Section I is devoted to fires in which the behavior of sprinklers was, for the reasons given, unsatisfactory.

Section II is a statistical record of all reports of sprinkler fires in the files of the Association upon which the information obtained is sufficiently complete for statistical purposes.

In each table the results of the current year ending February 1, 1927, are given, and these are compared with the results of the total thirty-one year record ending at that time.

The annual sprinkler tabulation is published this year for the thirty-first consecutive year, a notable record in continuity of this activity of the Association. The tables show the actual fire experience with automatic sprinkler equipments in thirty-seven thousand fires. This is not intended as a complete statistical record of fires occurring in sprinklered properties; it includes only those fires reported to the Department of Fire Record in sufficient detail to give the data necessary for the tables. This is probably only a fraction of the total number of fires occurring in buildings under sprinkler protection, but with a total of 37,000 fires in the record and current reports being received at the rate of more than two thousand a year, there can be no doubt but that this summary as a whole is typical and completely representative. An exception to this statement may be made in the case of the detailed records of experience in some occupancies where only a comparatively small number of fires are reported. In order to maintain the continuity of the tables from year to year it is necessary to have every occupancy classification appear, even though there be but one sprinklered fire reported. It is obvious, however, that conclusions should not be drawn as to the effectiveness of sprinklers in an occupancy where the number of fires reported is so small that the efficiency percentage may be distorted by the results of some one unusual fire.

The several tables showing sprinkler performance are divided into columns of cases where sprinklers "extinguished fire" and cases where sprinklers "held fire in check," both of these being classed as satisfactory performance. The distinction between these two classifications is necessarily more or less arbitrary, depending upon the judgment of the original inspector. The great majority of the fires in the "held in check" columns are cases where hose streams or chemicals were used to extinguish fire in spaces which water from the sprinkler did not reach because of obstructions to distribution, concealed spaces or unsprinklered portions, but where sprinklers functioned satisfactorily in preventing the spread of fire.

The total number of sprinklered fire reports received during the past year is 2647. The number of fires in which the sprinklers were not a factor* or which were discovered and extinguished before there was sufficient heat to open the sprinklers was 625.

SECTION I.

Summary of Unsatisfactory Sprinkler Fires

	1926-1927 No. of Fires	1926-1927 Per Cent	1897-1927, incl. No. of Fires	1897-1927, incl. Per Cent
Water shut off sprinklers	44	46.4	485	31.2
Generally defective equipment	4	4.2 }	303	19.5
Unsprinklered portions	9	9.5 }		
Defective water supply or supplies	8	8.4	138	8.9
Sprinkler system crippled due to freezing	1	1.0	43	2.7
Slow operation of dry system or defective valve	2	2.1	40	2.5
Slow or defective operation of high test heads	..	..	25	1.6
Faulty building construction, concealed spaces, vertical openings, etc.	5	5.3	78	4.9
Obstruction to distribution	6	6.3	89	5.7
Hazard of occupancy too severe for average sprinkler equipment	4	4.2	89	5.7
Explosion crippled sprinkler system	2	2.1	68	4.4
Exposure or conflagration	..	..	72	4.6
Plugged heads (included with Miscellaneous prior to 1921)	2	2.1	13	.8
Miscellaneous	8	8.4	115	7.5
Total	95		1558	

Fires in Which Failure Was Due to Water Shut Off Sprinklers

	1926-1927 No. of Fires	1897-1927 No. of Fires
Water shut off for unknown reason, neglect or carelessness	13	168
Water shut off before fire was out or fire rekindled	9	77
Water shut off due to accidents or repairs	8	79
Water shut off to prevent freezing	11	108
Water shut off, probably incendiary	1	8
Water shut off, leaky dry system	..	11
Water shut off, defective gate valve	..	8
Water shut off, miscellaneous	2	26
Total	44	485

SECTION II.

Annual Revision of Sprinkler Fire Tables.

In the following tables is given a summary of fires occurring in properties equipped with automatic sprinklers. The total number of such fires reported during the past year is 2647, which includes 625 fires where no sprinklers were opened. Several reports were also received in which the data was incomplete, and these were not used in the summary. It may be noted that the total number of fires does not agree throughout all the tables. This is because some of the reports of fires prior to 1909 were not considered sufficiently complete to include in all the tables, and hence appear in some tables, but not in others.

*By "not a factor" is meant fires that occur in unsprinklered portions of a building.

Table No. 1—Number of Sprinklers Operating.

No. of Fires, 1926-1927

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	596	37.6	69	18.6	8	673	33.8
2	345	21.7	52	13.9	2	399	20.0
3	127	8.1	31	8.3	2	160	8.0
4	108	6.7	26	7.0	1	135	6.7
5	56	3.5	16	4.3	1	73	3.7
6	42	2.6	23	6.2	1	66	3.3
7	31	2.0	14	3.7	..	45	2.3
8	29	1.8	14	3.7	..	43	2.2
9	27	1.7	9	2.4	..	36	1.8
10	20	1.3	14	3.7	..	34	1.7
11	17	1.0	5	1.3	..	22	1.1
12	18	1.1	10	2.7	1	29	1.5
13	9	.5	2	.5	..	11	.6
14	12	.8	4	1.0	1	17	.9
15	15	.9	3	.8	1	19	1.0
16 to 20	31	2.0	13	3.5	..	44	2.2
21 to 25	24	1.5	16	4.3	..	40	2.0
26 to 30	13	.8	6	1.6	..	19	1.0
31 to 35	6	.4	9	2.4	..	15	.8
36 to 40	7	.4	7	1.9	2	16	.8
41 to 50	6	.4	5	1.3	..	11	.6
51 to 75	18	1.1	7	1.9	..	25	1.3
76 to 100	12	.8	4	1.0	..	16	.8
Over 100	21	1.3	15	4.0	2	38	1.9
No Data	12		5		19	36	
Total	1602		379		41	2022	

No. of Fires, 1897-1927, inclusive

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	10885	36.8	1191	19.5	64	12140	33.7
2	5427	18.2	831	13.7	29	6287	17.4
3	2991	10.0	512	8.4	15	3518	9.8
4	2104	7.1	446	7.3	16	2566	7.1
5	1282	4.3	289	4.7	8	1579	4.4
6	1038	3.5	278	4.6	7	1323	3.7
7	714	2.4	203	3.3	5	922	2.6
8	677	2.3	178	2.9	7	862	2.4
9	438	1.5	139	2.3	5	582	1.6
10	394	1.3	120	1.9	11	525	1.5
11	288	1.0	110	1.9	4	402	1.1
12	332	1.1	125	2.0	4	461	1.3
13	192	.6	91	1.5	5	288	.8
14	225	.8	97	1.6	3	325	.9
15	183	.6	92	1.5	2	277	.8
16 to 20	634	2.1	269	4.4	9	912	2.5
21 to 25	370	1.2	208	3.4	4	582	1.6
26 to 30	263	.9	129	2.1	7	399	1.1
31 to 35	166	.6	86	1.4	3	255	.7
36 to 40	152	.5	83	1.4	2	237	.7
41 to 50	174	.6	109	1.8	1	284	.8
51 to 75	260	.9	153	2.5	2	415	1.2
76 to 100	114	.4	78	1.3	3	195	.5
Over 100	379	1.3	278	4.6	11	668	1.8
No Data	55		42		433	530	
Total	29737		6137		660	36534	
Water shut off sprinklers						270	
Total						36804	

Table No. 2—Number of Sprinklers Operating.

No. of Fires, 1897-1927, inclusive

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	10885	36.6	1191	19.6	64	12140	33.4
2 or less	16312	54.9	2022	33.2	93	18427	51.1
3 or less	19303	65.0	2534	41.5	108	21945	60.8
4 or less	21407	72.1	2980	48.8	124	24511	68.1
5 or less	22689	76.5	3269	53.6	132	26090	72.2
6 or less	23727	79.5	3547	58.2	139	27413	76.3
7 or less	24441	82.2	3750	61.6	144	28335	78.6
8 or less	25118	84.6	3928	64.5	151	29197	80.8
9 or less	25556	85.9	4067	66.8	156	29779	82.7
10 or less	25950	87.1	4187	68.6	167	30304	84.3
11 or less	26238	88.2	4297	70.5	171	30706	85.2
12 or less	26570	89.2	4422	72.5	175	31167	86.4
13 or less	26762	89.9	4513	74.1	180	31455	87.4
14 or less	26987	90.8	4610	75.8	183	31780	88.2
15 or less	27170	91.3	4702	77.3	185	32057	89.1
20 or less	27804	93.8	4971	81.7	194	32969	91.5
25 or less	28174	94.6	5179	85.0	198	33551	93.2
30 or less	28437	95.6	5308	87.0	205	33950	94.3
35 or less	28603	96.3	5394	88.6	208	34205	95.0
40 or less	28755	96.7	5477	90.0	210	34442	95.6
50 or less	28929	97.3	5586	91.7	211	34726	96.3
75 or less	29189	98.1	5739	94.2	213	35141	97.5
100 or less	29303	98.7	5817	95.5	216	35336	98.1
Over 100	379	1.3	278	4.5	11	668	1.9
No Data	55		42		433	530	
	29737		6137		660	36534	
Water shut off sprinklers						270	
Total						36804	

Table No. 3—Effect of Sprinklers.

	1926-1927 No. of Fires	%	1897-1927, incl. No. of Fires	%
Practically or entirely extinguished	1406	69.5	24673	67.0
Held fire in check	521	25.8	10559	28.7
Total Satisfactory	1927	95.3	35232	95.7
Unsatisfactory	95	4.7	1558	4.3
Total	2022		36790	

Table No. 4. Effect of Sprinklers by Class of Occupancy.

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Abrasive Works	7	70.0	2	20.0	9	90.0	1	10.0	10
Agricultural Implements	58	56.9	39	38.2	97	95.1	5	4.9	102
Aluminum Works	3	75.0	1	25.0	4	100.0	..	..	4
Apartments	58	90.7	6	9.3	64	100.0	..	..	64
Artificial Flowers	13	100.0	..	..	13	100.0	..	..	13
Artificial Leather	16	41.0	21	53.9	37	94.9	2	5.1	39
Asbestos Works	10	62.5	4	25.0	14	87.5	2	12.5	16
Automobile and Bicycle Factories	185	57.7	119	37.2	304	94.9	16	5.1	320
Awning Factories	6	66.7	3	33.3	9	100.0	..	..	9
Bag Factories	31	58.5	19	35.9	50	94.4	3	5.6	53
Bakeries	105	74.5	30	21.3	135	95.8	6	4.2	141
Basket Factories	8	88.9	1	11.1	9	100.0	..	..	9
Battery Works	18	66.7	8	29.6	26	96.3	1	3.7	27
Bolt, Nut and Screw Works	21	63.7	11	33.3	32	97.0	1	3.0	33
Boot and Shoe Shops	712	73.7	221	22.9	933	96.6	33	3.4	966
Bottle Caps and Seals	23	53.5	20	46.5	43	100.0	..	..	43
Bottling Works	5	71.4	1	14.3	6	85.7	1	14.3	7
Braid Mills	33	82.5	6	15.0	39	97.5	1	2.5	40
Brass Works	61	70.2	23	26.4	84	96.6	3	3.4	87
Breweries	5	83.4	1	16.6	6	100.0	..	..	6
Broom Factories	12	60.0	6	30.0	18	90.0	2	10.0	20
Brush Factories	27	71.1	11	28.9	38	100.0	..	..	38
Button Factories	59	82.0	11	15.2	70	97.2	2	2.8	72
Candle Factories	6	46.1	7	53.9	13	100.0	..	..	13
Candy Factories	154	73.0	51	24.2	205	97.2	6	2.8	211
Canning Factories	13	56.6	7	30.4	20	87.0	3	..	23
Car Houses	33	44.0	35	46.7	68	90.7	7	9.3	75
Car Works	86	61.9	48	34.5	134	96.4	5	3.6	139
Carpet Mills	175	62.5	95	33.9	270	96.4	10	3.6	280
Carriage and Auto Body Factories	133	59.6	71	31.9	204	91.5	19	8.5	223
Celluloid (Pyroxylin Plastic)	179	66.1	62	22.9	241	89.0	30	11.0	271
Cement and Plaster Works	8	66.6	2	16.7	10	83.3	2	16.7	12
Cereal Mills	36	65.5	12	21.8	48	87.3	7	12.7	55
Chemical and White Lead	125	59.8	67	32.0	192	91.8	17	8.2	209
Clothing Factories	1653	85.4	270	13.9	1923	99.3	13	.7	1936
Clubs	17	73.9	4	17.4	21	91.3	2	8.7	23
Coffee and Spice Mills	64	68.2	26	27.6	90	95.8	4	4.2	94
Coffin Factories	62	72.1	20	23.3	82	95.4	4	4.6	86
Cold Storage Plants	9	64.3	5	35.7	14	100.0	..	..	14
Cooperage Plants	50	56.8	27	30.7	77	87.5	11	12.5	88
Cordage Works	226	64.3	113	32.1	339	96.4	13	3.6	352
Cork Factories	26	48.2	24	44.4	50	92.6	4	7.4	54
Corset Factories	11	68.9	4	24.9	15	93.8	1	6.2	16
Cotton Ginnery	8	61.6	5	38.4	13	100.0	..	..	13
Cotton Mills	4477	62.3	2615	36.3	7092	98.6	87	1.4	7179
Cotton Seed Oil Mills	39	47.6	29	35.4	68	83.0	14	17.0	82
Cotton Warehouses	151	45.6	152	46.2	303	91.8	27	8.2	330
Cutlery and Tools	28	63.6	14	31.9	42	95.5	2	4.5	44
Department Stores	491	78.3	118	18.8	609	97.1	18	2.9	627
Distilleries	10	62.5	5	31.3	15	93.8	1	6.2	16
Doll Factories	49	63.6	28	36.4	77	100.0	..	..	77
Drug Houses	198	80.8	43	17.6	241	98.4	4	1.6	245
Dry Cleaning Establishments	8	61.5	5	38.5	13	100.0	..	..	13
Dry Goods Stores	271	86.0	43	13.7	314	99.7	1	.3	315
Dwelling	..	..	..	..	..	..	1	100.0	1
Dyeing, Bleaching and Finishing	176	53.7	138	42.0	314	95.7	14	4.3	328
Electrical Appliances	301	69.1	126	29.1	427	98.2	8	1.8	435
Electric Light and Power Plants	6	37.6	7	43.7	13	81.3	3	18.7	16
Elevators, Grain	28	35.9	28	35.9	56	71.8	22	28.2	78
Excelsior Factories	25	71.5	7	20.0	32	91.5	3	8.5	35

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Fertilizer Plants	28	63.6	12	27.3	40	90.9	4	9.1	44
Flax and Linen Mills	37	51.4	35	48.6	72	100.0	..	..	72
Flour and Grist Mills	70	56.5	36	29.0	106	85.5	18	14.5	124
Forge and Smithy	17	68.0	7	28.0	24	96.0	1	4.0	25
Foundries	176	57.0	118	38.5	294	95.5	14	4.5	308
Fur Works	80	92.0	5	5.7	85	97.7	2	2.3	87
Furniture Factories	672	65.9	270	26.5	942	92.4	78	7.6	1020
Furniture Stores	68	77.5	15	17.0	83	94.5	5	5.5	88
Garages	253	69.1	106	29.0	359	98.1	7	1.9	366
Garbage Reduction Plants	3	60.0	1	20.0	4	80.0	1	20.0	5
Gas Plants	2	50.0	2	50.0	4	100.0	..	..	4
General Stores	24	80.0	6	20.0	30	100.0	..	..	30
Glass Works	59	51.4	42	36.5	101	87.9	14	12.1	115
Glove Factories	13	72.3	4	22.2	17	94.5	1	5.5	18
Glue Factories	9	50.0	7	38.9	16	88.9	2	11.1	18
Groceries	128	81.5	23	14.7	151	96.2	6	3.8	157
Hardware Stores	89	86.5	13	12.5	102	99.0	1	1.0	103
Harness and Fancy Leather	142	82.5	29	17.0	171	99.5	1	.5	172
Hat Factories	234	78.0	54	18.0	288	96.0	12	4.0	300
Hatters' Fur Works	17	54.9	9	29.0	26	83.9	5	16.1	31
Hotels	47	77.0	12	19.7	59	96.7	2	3.3	61
Ice Plants	2	66.7	1	33.3	3	100.0	..	..	3
Incandescent Lamp Works	23	63.9	13	36.1	36	100.0	..	..	36
Institutions	11	64.7	5	29.4	16	94.1	1	5.9	17
Insulated Wire Works	39	64.0	22	36.0	61	100.0	..	..	61
Jewelry Factories	155	86.6	18	10.0	173	96.6	6	3.4	179
Junk Shops	23	76.7	6	20.0	29	96.7	1	3.3	30
Knitting Mills, Cop Yarn	64	66.7	25	26.0	89	92.7	7	7.3	96
Knitting Mills, Full Process	523	65.6	247	31.0	770	96.6	27	3.4	797
Laundries	85	74.0	26	22.5	111	96.5	4	3.5	115
Lead Pencil Factories	16	66.7	7	29.2	23	95.9	1	4.1	24
Linseed Oil Works	19	52.8	12	33.3	31	86.1	5	13.9	36
Machine Works	323	67.6	131	27.4	454	95.0	24	5.0	478
Mail Order Houses	37	94.9	2	5.1	39	100.0	..	..	39
Match Factories	56	74.7	15	20.0	71	94.7	4	5.3	75
Mattress Factories	433	69.2	181	28.9	614	98.1	12	1.9	626
Mercantile (Miscellaneous)	758	81.5	149	16.0	907	97.5	23	2.5	930
Metal Reduction Works	11	68.9	5	31.1	16	100.0	..	..	16
Metal Workers†	917	63.6	465	32.2	1382	95.8	61	4.2	1443
Miscellaneous	561	72.2	172	22.1	733	94.3	44	5.7	777
Morocco Leather Shops	49	53.8	30	33.0	79	86.8	12	13.2	91
Motion Pictures	83	81.3	15	14.7	98	96.0	4	4.0	102
Multiple Occupancy	3	42.9	3	42.9	6	85.8	1	14.2	7
Munition Factories	25	44.7	22	39.3	47	84.0	9	16.0	56
Musical Instrument Factories	142	68.6	59	28.5	201	97.1	6	2.9	207
Office Buildings	51	86.5	8	13.5	59	100.0	..	..	59
Oilcloth and Linoleum Works	44	31.9	73	52.9	117	84.8	21	15.2	138
Oil Clothing Factories	13	68.4	5	26.3	18	94.7	1	5.3	19
Oil Refineries—Animal	2	40.0	3	60.0	5	100.0	..	..	5
—Mineral	7	77.8	2	22.2	9	100.0	..	..	9
—Vegetable	3	23.1	8	61.5	11	84.6	2	15.4	13
Packing House and Slaughter	160	70.5	58	25.6	218	96.1	9	3.9	227
Paint and Varnish Works	222	66.0	101	30.1	323	96.1	13	3.9	336
Paper Box and Papeterie	235	77.0	64	21.0	299	98.0	6	2.0	305
Paper Mills	467	50.3	385	41.3	852	91.6	78	8.4	930
Patent Leather Works	11	36.7	15	50.0	26	86.7	4	13.3	30
Phonograph Works	27	75.0	8	22.2	35	97.2	1	2.8	36
Photograph Works	43	78.2	11	20.0	54	98.2	1	1.8	55
Picture Frame Factories	49	66.2	19	25.7	68	91.9	6	8.1	74
Piers and Wharves	7	38.9	9	50.0	16	88.9	2	11.1	18
Plumbers' Supplies	29	74.4	10	25.6	39	100.0	..	..	39

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Potteries	49	62.8	23	29.5	72	92.3	6	7.7	78
Printing and Lithographing	811	81.5	166	16.7	977	98.2	18	1.8	995
Public Buildings	..	..	1	100.0	1	100.0	..	..	1
Pulp Mills	34	34.4	42	42.4	76	76.8	23	23.2	99
Railroad Property	2	33.3	3	50.0	5	83.3	1	16.7	6
Restaurants	77	76.2	21	20.8	98	97.0	3	3.0	101
Rice Mills	2	40.0	1	20.0	3	60.0	2	40.0	5
Rolling, Wire and Tube Works	36	59.0	23	37.7	59	96.7	2	3.3	61
Roofing Works	35	40.6	42	48.9	77	89.5	9	10.5	86
Rubber Cloth Factories	32	58.2	22	40.0	54	98.2	1	1.8	55
Rubber Reclaiming Works	8	33.3	10	41.7	18	75.0	6	25.0	24
Rubber Works	172	49.0	158	45.0	330	94.0	21	6.0	351
Saw and Planing Mills	93	42.9	73	33.6	166	76.5	51	23.5	217
Schools	16	80.0	4	20.0	20	100.0	..	..	20
Ships and Shipbuilding	6	46.1	6	46.1	12	92.2	1	7.8	13
Shoddy Mills	229	66.1	95	27.5	324	93.6	22	6.4	346
Shoe Mfg. Accessories	57	68.0	25	29.7	82	97.7	2	2.3	84
Shoe Stores	54	88.5	7	11.5	61	100.0	..	..	61
Silk Mills	107	76.0	29	20.5	136	96.5	5	3.5	141
Skin Mills	10	83.3	2	16.7	12	100.0	..	..	12
Soap Manufacturing	39	75.0	11	21.1	50	96.1	2	3.9	52
Stables	17	74.0	6	26.0	23	100.0	..	..	23
Stamping and Sheet Metal Works	93	60.4	48	31.1	141	91.5	13	8.5	154
Starch and Glucose Works	14	53.8	4	15.4	18	69.2	8	30.8	26
Sugar Refineries	32	57.1	22	39.3	54	96.4	2	3.6	56
Tanneries	48	50.0	40	41.7	88	91.7	8	8.3	96
Tenant Building	807	75.2	211	19.6	1018	94.8	56	5.2	1074
Theatres	57	73.0	16	20.6	73	93.6	5	6.4	78
Tobacco Factories	67	72.0	23	24.8	90	96.8	3	3.2	93
Trunk Factories	33	75.0	8	18.2	41	93.2	3	6.8	44
Wall Paper Factories	21	67.8	6	19.4	27	87.2	4	12.8	31
Warehouses	432	70.4	151	24.6	583	95.0	31	5.0	614
Waste and Batting Mills	300	60.4	175	35.6	475	96.0	20	4.0	495
Waste Paper and Rag Shops	104	64.6	53	32.9	157	97.5	4	2.5	161
Weaving Mills	134	65.7	64	31.4	198	97.1	6	2.9	204
Window Shade Factories	13	76.4	2	11.8	15	88.2	2	11.8	17
Woodworkers, Class A*	168	55.0	95	31.2	263	86.2	42	13.8	305
Woodworkers, Class B*	165	53.0	117	37.7	282	90.7	29	9.3	311
Woodworkers, Class C*	143	60.0	82	34.5	225	94.5	13	5.5	238
Woodworkers, Class D*	104	57.8	54	30.0	158	87.8	22	12.2	180
Woodworkers, Class E*	210	67.0	89	28.5	299	95.5	14	4.5	313
Woodworkers, Class F*	41	62.2	21	31.8	62	94.0	4	6.0	66
Woolen Mills	995	70.0	361	25.4	1356	95.4	66	4.6	1422
Wool Storehouses	28	68.4	11	26.7	39	95.1	2	4.9	41
Worsted Mills	74	56.5	43	32.8	117	89.3	14	10.7	131
Total Sprinkler Fires	24,673		10,559		35,232		1,558		36,790

*The Woodworkers are classed as follows:

Class A. Interior Woodwork, builders' supplies (including veneer works).

Class B. Box Factories (including cigar boxes).

Class C. Miscellaneous Woodworkers. Steam power tenant Woodworkers. Woodworkers where there is a lack of detailed information as to class.

Class D. Sash, Door and Blind Factories.

Class E. Hard Wood Turning (wheels, pipes, novelties, bobbins, spools, etc., last and wood heel factories).

Class F. Pails and Woodenware (plates, wooden bowls, tubs, etc.).

†Other Metal Working Occupancies are included under Agricultural Implements; Automobile and Bicycle Factories; Bolt, Nut and Screw Works; Electrical Appliances; Forge and Smithy; Foundries; Machine Works; Rolling, Wire and Tube Works; and Stamping and Sheet Metal Works.

Table 5. Classification of Unsatisfactory Sprinkler Fires by Occupancy.

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Abrasive Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Agricultural Implements	3	1	..	..	..	..	..	..	1	..	..	..	..	5
Artificial Leather	..	..	..	..	..	..	1	..	..	1	..	..	..	2
Asbestos Works	..	..	1	..	..	..	..	..	..	1	..	..	..	2
Automobile and Bicycle	7	1	1	..	..	..	..	4	..	2	1	..	..	16
Bag Factories	..	..	..	..	..	1	..	1	..	..	..	1	..	3
Bakeries	3	1	..	..	..	..	..	..	..	..	..	..	2	6
Battery Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Bolt, Nut & Screw Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Boot and Shoe Shops	14	5	2	..	..	1	..	1	..	2	5	..	3	33
Bottling Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Braid Mill	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Brass Works	1	1	..	..	..	..	..	..	..	..	..	..	1	3
Broom Factories	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Button Factories	..	..	..	2	..	..	..	..	..	..	..	..	..	2
Candy Factories	2	..	..	..	1	..	2	..	..	..	..	..	1	6
Canning Works	1	..	..	..	1	..	..	..	..	..	1	..	..	3
Car Houses	2	2	1	..	1	..	..	1	..	..	..	..	..	7
Car Works	2	1	..	..	..	..	1	1	..	..	..	..	..	5
Carpet Mills	4	2	3	..	..	..	..	1	..	..	..	..	..	10
Carriage and Automobile Body Factories	4	4	3	..	2	..	..	2	1	..	2	1	..	19
Celluloid (Pyroxylin)	3	1	3	1	1	..	2	2	10	5	2	..	..	30
Cement & Plaster Works	..	1	..	..	1	..	..	..	..	..	..	..	..	2
Cereal Mills	..	2	1	..	..	..	..	1	..	3	..	..	..	7
Chemical & White Lead	3	4	..	..	..	..	..	..	4	5	..	..	1	17
Clothing Factories	4	1	2	1	..	..	2	2	..	..	1	..	..	13
Clubs	1	..	..	..	..	..	1	..	..	..	..	..	..	2
Coffee and Spice Mills	2	..	..	..	..	..	..	1	..	1	..	..	..	4
Coffin Factories	2	..	..	1	..	..	1	..	..	..	..	..	..	4
Cooperage Plants	1	4	..	..	..	1	..	4	..	..	1	..	..	11
Cordage Works	4	4	1	1	..	..	..	2	..	..	..	..	1	13
Cork Factories	1	..	1	..	..	..	..	..	..	1	..	..	1	4
Corset Factories	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Cotton Mills	28	22	8	2	1	1	5	1	3	..	..	3	13	87
Cotton Warehouses	14	1	2	..	..	..	1	4	2	..	..	..	3	27
Cotton Seed Oil Mills	3	5	2	..	..	..	..	..	1	..	..	..	3	14
Cutlery and Hardware	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Department Stores	8	4	..	..	1	..	1	1	..	..	2	..	1	18
Distilleries	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Drug Houses	..	..	..	..	..	..	..	..	..	..	3	..	1	4
Dry Goods Stores	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Dwellings	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Dyeing, Bleaching and Finishing	5	3	1	..	1	1	..	1	..	..	1	..	1	14
Electrical Appliances	2	..	2	..	..	..	1	1	..	..	..	..	2	8
Electric Light and Power Plants	1	1	..	..	..	..	..	1	..	..	..	..	..	3
Elevators, Grain	1	5	5	..	2	..	2	1	..	3	2	..	1	22
Excelsior Factories	..	..	2	..	..	..	..	..	1	..	..	..	..	3

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Fertilizer Plants	2	1	..	..	1	..	..	..	..	..	..	..	..	4
Flour and Grist Mills	5	2	1	..	1	..	1	1	1	3	2	..	1	18
Forge and Smithy	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Foundries	11	1	1	..	..	..	..	..	..	1	..	..	..	14
Fur Works	..	..	..	..	..	..	1	..	..	..	..	..	1	2
Furniture Factories	26	16	3	3	1	..	3	9	8	1	4	2	2	78
Furniture Stores	4	..	..	..	..	..	1	..	..	..	..	..	..	5
Garages	4	..	..	..	..	..	..	2	..	..	..	..	1	7
Garbage Reduction Plants	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Glass Works	2	3	2	1	..	..	2	1	..	..	..	..	3	14
Glove Factories	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Glue Factories	1	..	..	..	..	..	..	..	1	..	..	..	..	2
Groceries	4	..	1	..	1	..	..	..	..	..	..	..	..	6
Hardware Stores	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Harness & Fancy Leather	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Hat Factory	4	3	1	..	1	..	..	1	..	..	..	..	2	12
Hatters' Fur Mfg	3	..	1	..	..	..	1	..	..	..	..	..	..	5
Hotels	1	..	1	..	..	..	..	..	..	..	..	..	..	2
Institutions	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Jewelry Shops	2	1	..	2	..	..	1	..	..	..	..	..	..	6
Junk Shops	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Knitting, Cop Yarn	1	1	3	..	..	..	..	1	..	1	..	..	..	7
Knitting, Full Process	8	10	5	1	1	..	1	..	..	1	..	..	..	27
Laundries	2	..	1	..	..	..	..	1	..	..	..	..	..	4
Lead Pencil Works	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Linseed Oil Works	1	..	..	..	..	..	..	..	1	2	..	..	1	5
Machine Shops	15	5	1	1	..	1	..	..	..	1	..	..	..	24
Match Factories	2	..	..	..	..	..	..	..	1	..	..	..	1	4
Mattress Factories	7	2	..	1	..	..	..	2	..	..	..	..	..	12
Mercantile (Miscel.)	8	4	1	2	..	..	3	..	..	..	4	..	1	23
Metal Workers†	20	15	3	..	..	2	4	2	4	3	2	2	4	61
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Morocco Leather Shops.	5	3	..	..	2	..	1	..	..	..	..	..	1	12
Motion Pictures	2	1	..	..	..	..	..	..	1	..	..	..	..	4
Multiple Occupancy	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Munitions Factories	2	..	..	1	..	..	..	..	4	1	..	..	1	9
Musical Instrument Factories	1	3	..	..	..	..	1	..	..	..	1	..	..	6
Oilcloth and Linoleum Works	..	5	..	..	..	..	1	3	12	..	..	..	..	21
Oil Clothing	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Oil Refinery (Vegetable)	1	..	1	..	..	..	..	..	..	..	..	..	..	2
Packing House and Slaughter	1	2	1	..	2	..	..	..	1	1	..	..	1	9
Paint and Varnish Works	1	3	5	..	..	..	3	..	1	..	..	..	..	13
Paper Box and Papeterie	4	1	..	..	1	..	..	..	..	..	..	..	..	6
Paper Mills	19	21	8	3	1	3	2	1	4	2	2	1	11	78
Patent Leather Works	1	..	1	1	..	..	1	..	..	..	..	..	..	4
Phonograph Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Photograph Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to Distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Picture Frame Factories	1	2	1	1	..	..	..	1	..	..	..	..	..	6
Piers and Wharves	..	1	1	..	..	..	..	..	..	..	..	..	..	2
Potteries	2	1	1	1	..	..	..	..	..	1	..	..	..	6
Printing and Lithographing	7	4	1	..	..	..	1	1	..	..	3	..	1	18
Pulp Mills	9	3	4	..	1	1	1	..	1	1	..	..	2	23
Railroad Property	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Restaurants	1	1	..	..	..	..	1	..	..	..	..	..	..	3
Rice Mills	..	1	1	..	..	..	..	..	..	..	..	..	..	2
Rolling, Wire and Tube Works	..	..	..	..	..	1	1	..	..	..	..	..	..	2
Roofing Works	3	2	..	1	..	..	1	1	..	1	..	..	..	9
Rubber Cloth Mill	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Rubber Reclaiming Works	2	..	..	..	..	..	1	1	1	1	..	..	..	6
Rubber Works	8	..	..	1	..	..	..	1	5	4	..	1	1	21
Saw and Planing Mills	12	10	3	..	4	1	6	2	4	..	5	1	3	51
Ships and Shipbuilding	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Shoddy Mills	6	3	6	..	1	3	1	1	..	..	..	..	1	22
Shoe Mfg. Accessories	..	1	..	..	..	..	..	..	..	..	..	..	1	2
Silk Mills	2	1	..	..	..	..	..	..	..	1	..	..	1	5
Soap Manufacturing	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Stamping and Sheet Metal Works	1	4	1	..	1	..	2	1	..	..	2	..	1	13
Starch and Glucose Mills	..	..	..	..	..	..	..	..	1	7	..	..	..	8
Sugar Refineries	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Tanneries	1	1	..	3	..	..	..	..	1	..	1	..	1	8
Tenant Manufacturing	28	8	2	3	1	..	3	1	1	..	6	..	3	56
Theatres	3	2	..	..	..	..	..	..	..	..	..	..	..	5
Tobacco Factories	1	1	..	..	..	..	..	..	..	..	1	..	..	3
Trunk Factories	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Wall Paper Factories	..	..	1	..	..	..	..	1	1	..	1	..	..	4
Warehouses	12	4	3	..	2	..	1	4	1	..	..	..	4	31
Waste and Batting Mills	6	4	3	1	..	1	..	2	2	..	..	..	1	20
Waste Paper and Rag Shops	3	1	..	..	..	..	..	..	..	..	..	..	..	4
Weaving Mills	1	1	2	1	..	..	..	1	..	..	..	..	..	6
Window Shade Factories	..	..	..	1	..	..	..	..	1	..	..	..	..	2
Woodworkers, Class A*	11	9	2	..	1	1	1	6	..	3	3	1	4	42
Woodworkers, Class B*	6	8	2	2	..	2	1	1	..	3	2	..	2	29
Woodworkers, Class C*	4	4	2	..	..	..	..	3	..	..	..	..	..	13
Woodworkers, Class D*	2	9	..	1	1	..	..	..	..	2	4	..	3	22
Woodworkers, Class E*	5	2	1	..	2	1	2	..	..	..	1	..	..	14
Woodworkers, Class F*	2	..	1	..	..	..	..	1	..	..	..	..	..	4
Woolen Mills	16	18	13	1	..	2	4	..	1	..	3	..	8	66
Wool Storehouses	..	2	..	..	..	..	..	..	..	..	..	..	..	2
Worsted Mills	3	3	2	1	..	..	1	..	..	..	..	..	4	14
Total Unsatisfactory Fires	485	303	138	43	40	25	78	89	89	68	72	13	115	1558

*See detailed classification of Woodworkers as given in note under Table No. 4.

†See note on Metal Workers under Table No. 4.

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